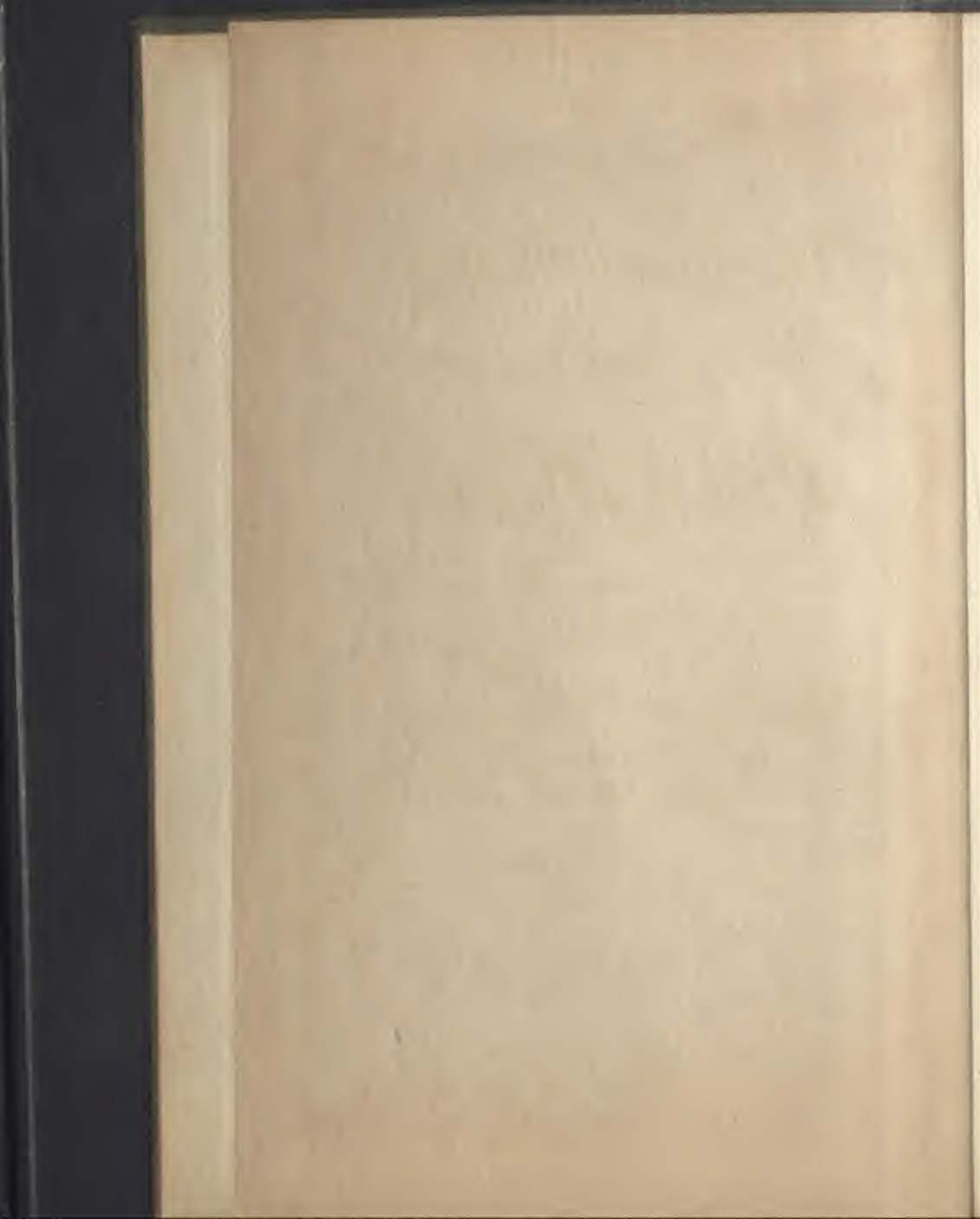


Repairing  
the  
Pianoforte



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*Repairing*

*the*

*Pianoforte*

*With Chapters on Regulating,  
Toning, Polishing, Case  
Repairing, &c.*

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# *Repairing the Pianoforte*

## INTRODUCTION.

**C**OMPLAINT has been made, frequently and justly, that the professional education of the average pianoforte tuner is incomplete and very unsatisfactory, and that his usefulness is consequently greatly limited. There are many causes and reasons for this state of things,—some of them within the tuner's own control, others not. The present system of specialising which obtains in pianoforte factories tends to make the tuner a tuner and nothing else. He is apprenticed to tuning and no more; and for anything he may learn outside his particular department, he must be indebted to his own keenness of observation and some mechanical instinct. Sometimes the young tuner gets but little definite assistance or encouragement from his employer. Upon the other hand, his opportunities may be of the very best and widest; but he himself may be content to let them slip through his fingers and so remain simply a tuner. Such a man is useless as an



outdoor hand, as many dealers have found through sad and bitter experience. He may be a decent tuner; but if he cannot mend, and that properly, a broken hammer shank, or replace a vellum hinge, or do any of the thousand and one little odd jobs that come in his way, he often gives more trouble than he is worth, besides all which he cannot claim to be a fully qualified man.

There is no royal road to competency in this profession; and the only right and proper road is that through some properly equipped factory where the processes of manufacture may be seen in progress from start to finish and studied at every stage; where the actual construction may be watched, and the why and wherefore of all things connected therewith may be readily learnt should the worker so desire.

At the same time, there must be many who, though good tuners, have not had the opportunities of gaining first hand the practical knowledge and experience without which, as has already been pointed out, no real tuner's education can be said to be complete; and it is with a view of helping such that these brief hints have been compiled, with reference to such regulating and repairs as may come fairly within ordinary experience.

In the manufacture of modern pianofortes—having secured strength and solidity in the construction of the back, bracings, wrest plank, and frame; and having also secured response and sonority by proper construction and adjustment of sound-board and bridges—the prevailing feature thenceforward is regularity, which means perfect equality. To secure this regularity, we must be able to regulate.

Regularity begins at what is known as the "scale" of the piano itself, which scale is a design or template indicating the exact position of wrest pins, bridge and bridge pins, the arrangement and spacing of which must be made with perfect exactness and regularity, and to correspond with the action to be supplied later on.

Regularity is demanded of the stringer that the number of coils round each pin in each particular row shall be the same, and that the lengths of steel from top bridge to pin shall lie upon the same horizontal plane.

The action maker must adhere strictly to the standard of regularity laid down in the scale, that his hammer

butts shall correspond with the string spaces, his stickers to the butts, and his levers to the stickers.

The hammer coverer must provide a graduated regularity throughout his heads and their covering; whilst the key maker, again, must so arrange his keys as to correspond exactly with the action levers and come into line with the action, hammers, and strings.

Thus we see that regularity is the keynote as it were of the whole working construction, and upon these lines we must proceed to regulate; and in order to put the matter before the reader as simply as possible, the whole course of treatment necessary for the repairing of what may be regarded as "a bad case" will be indicated and explained under separate headings.

## THE ACTION.

AS a preliminary to a consideration of the repair and regulation of the action, both horizontal and upright, a short sketch of the origin and development of the modern action is given.

To go back before the days of the pianoforte, it is perhaps well known that the harpsichord was the popular instrument both in England and abroad for many years both prior to and subsequent to the introduction of the pianoforte; and much persuasion was necessary before the general public could be brought to see the immense superiority of the pianoforte over the harpsichord. The history of the pianoforte reveals many instances of this tardy recognition of good inventions by the trade and by the public. The strings of the harpsichord were sounded by the action of quills which plucked the strings as the keys were depressed. The great drawback of this form of music making was the total absence of any expression of light and shade; that is to say, there was no means whereby a performer at the key-board could play either loud or soft. However gently or vigorously a key was depressed the result upon the string was practically the same. Hence it came about that, when in place of the quills a row of hammers was substituted, the power to give a hard or soft blow upon the string was at once brought within the performer's command, and the instrument so fitted soon became known as the forte-piano and later as the pianoforte. Naturally, the hammers fitted in the early pianos were exceedingly light compared with those in modern instruments, being in fact merely small levers with pieces of leather glued to the free ends. These hammers were knocked up by pads of leather fixed to the ends of pieces of brass wire which were inserted in the keys. No provision was made for escapement or for checking. This action was known by the name of the "old man's head" from the appearance of the mop-like arrangement under the hammer.

The action under consideration (Fig. 1) was very imperfect and liable to block or to miss striking the string, but it was extensively employed in the square pianos manufactured in England about the year 1760. It will be seen from the sketch what a simple affair this action was. If the mopstick (A) was too long the hammer would block, while on the other hand un-



FIG. 1.

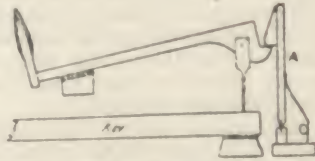
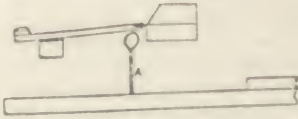


FIG. 2.

less the mopstick was of sufficient length it would fail to carry the hammer up to the string. The touch of these instruments was shallow and the wires very fine. It is indeed a matter for wonder that so much good music could have been composed for so crude an instrument. The dampers consisted of levers tipped with cloth which rested upon the strings and were raised by lifters on the ends of the keys. Although this action was so extensively used, a better arrangement had been invented some years before by Cristofori of Padua (who is now generally conceded to be the inventor of the pianoforte) in 1708. In the action of the early Cristofori pianos, an escapement device had already been introduced and a few years later the check was added. Scipione Maffei, describing the action by Cristofori in 1711, says:—

"Instead of the jacks that produced sound by quills, there is a little row of hammers to strike the string from below, the tops of which are covered with leather. Every hammer has the end inserted into a circular butt, that renders it movable; these butts are partially embedded and strung together in a receiver. Near the butt and the stem of the hammer there is a protecting part or support that, receiving the blow from beneath, raises the hammer and causes it to strike the string with whatever degree of force is given by the hand of the performer: hence the sound produced can be greater or less at the pleasure of the player."

The next stage in development took place about the year 1772, when an action was invented which differed in many respects from the one already described. This is now known as the Viennese action and the peculiarity of it is that the hammer

is reversed, the head being towards the key-board. A sketch of an action of this type is shown in Fig. 2. It will be noticed that instead of the hopper rising in the usual manner the hammer butt is made to rise, while what we term the hopper is a fixture. The dampers are of the lever type, lying on the strings and lifted by wires in the keys. In the action illustrated there was no provision for regulating the set-off to a nicety; but in many Viennese actions a set-off button is provided on the hopper. The hammer butt is of thin wood tapered to form the shank of the hammer and the centre pin upon which the hammer is pivoted consists of a double pointed steel pin sprung between the prongs of a brass fork which is screwed into the key. There are various forms of this action now in existence. Mozart, writing in 1777, says of a piano containing the Viennese action by John Andrew Stein of Augsburg:—

"In passages that require vigorous play, I can lift the finger or leave it on the note, for the sound is not prolonged beyond the instant in which it is heard; it never blocks nor does it even fail to sound as in other pianos.....his instruments have one quality found in them, above all they have the escape movement, without which it is almost impossible that a piano can render a well articulated sound. The hammers fall again as soon as they have touched the string, whether the finger be left on the key or not."

From this it will be gathered that there were many pianos in Mozart's time without any provision for the escape of the hammer. Stein's daughter Nannette, who had received some instruction in pianoforte making from her father, married Andreas Streicher of Vienna, and assisted her husband to improve the Viennese action so that the latter models gave very good results, though the touch is not quite so smooth as one could wish. Nevertheless, a pneumatic player has been satisfactorily fitted to a piano with one of these actions. In 1808 Sebastian Erard, who had probably fitted or made some Viennese actions, patented a repetition action which "affords the power of giving repeated strokes without missing or failure, by very small angular motions of the key itself." This invention was many years old before it was brought to the state of perfection necessary for public recognition, and it was not until 1821 that Pierre Erard took out a patent for a repetition action which was the forerunner of the now famous Erard grand action. The departure from the "old man's head" action seems to have been made when in 1786 John Geib patented a grasshopper action. This was what we know now as the hopper, and it was used in square pianos made by Geib for Longman & Broderip of Cheapside, who were afterwards amalgamated with Clementi, Collard & Collard. Several pianos by Geib are in existence with the Longman & Broderip name on the nameboard and containing the hopper action. When the patent expired this

action became the one used by practically every maker of repute; and it has been employed in upright pianos with but little modification, when the various forms of check action have now altogether superseded it.

In 1826 Robert Wornum patented his check action, which was so great an improvement upon the sticker action that it was at once put down as a failure by the pianoforte makers of that day; and it was years after its merits had been recognised abroad that English makers began to see something in the idea. Nowadays we should not think of asking which was the superior action, tape or sticker; but in the eighties or nineties of the last century this was a debatable point among pianoforte makers (in this country at least), and while we were arguing about this action foreigners were using it.

With this brief glance at pianoforte history (the reader may become better acquainted with historical matters on reference to any of the historical books published on the subject) we will proceed to notice the great difference between the sticker and the check action. One of the points of difference which would at once strike an observant mind would be that, whereas the sticker action depended mainly upon the pliability of leather or vellum for its hinges, the check action was provided with real hinges consisting of pins centred in cloth bushings. Another point of much importance is that, while in the check action the hammer is practically free to hit the strings, in the sticker action the hammer carries with it both a lever and a sticker, the latter usually weighted. This means that the hammer has to overcome the inertia of the weighted sticker before it leaves the strings; and, when we consider the great rapidity of the vibrations of the strings (especially in the treble portion of the instrument), it will be understood what an improvement is made in the tone by the use of a check action instead of a sticker.

It has been said with a good deal of truth that, while one could depress a key on a piano containing a sticker action without any sound resulting, this would be impossible with a good tape action; for, while the check action gives a firm and even touch and allows of the most delicate shades of expression, the sticker action is at the best uncertain, and after a little wear the hammers do not respond with equal readiness to the touch of the player.

After Wornum's action had become fairly well established and when it had been proved that it was possible to invent a better action than the one that had been in use for so many years, several inventors turned their attention to improving or to altering Wornum's invention. Several curious and more or less useful actions resulted; but, although modifications and improvements have been brought out, nothing has been found to replace satisfactorily the tape in ordinary check actions. Many actions—some of doubtful utility—have been brought forward



in which the tape was dispensed with, but the great invention which will finally dispose of the employment of a flexible cord or tape in the upright check action has still to be evolved.

One of the best known actions is undoubtedly the spring and loop action, due to the invention of Mr. Molineux and often named after him. In this action a spring and a loop of silk or mohair was introduced in place of the tape, which had the effect of keeping the sticker in the notch and at the same time of bringing the hammer back. This was probably one of the most successful inventions from a commercial point of view in connection with pianoforte actions; and the sole right to manufacture actions containing springs and loops was successfully maintained throughout the time the patent was valid. When the patent rights were about to expire (and indeed some time before) various action makers were busy producing actions of the spring and loop pattern, storing them in readiness for the day on which Molineux's patent would expire.

#### "BREAKING DOWN" THE ACTION.

After this dissertation on actions in general, attention must be directed to the more practical side, for which purpose it may be assumed that an action, thoroughly worn, is to be repaired or renewed throughout. The first thing is to get the action apart, technically called "breaking it down," which requires considerable care in order that later on all the parts shall go back in their original order and positions. A diagram of a sticker action will be found on page 75.

Have the bench quite clear. Lay the action on the bench back upwards. Now, commencing at the bass end, mark clearly and distinctly each hammer butt, each sticker, and each lever throughout. Always commence No. 1 at the bass end. Use a copying ink pencil, and make the figures carefully and distinctly. This may be a little more trouble, but it is a great saving of time and temper in the long run. Never trust to the original marks on action work.

Now turn the action (still back upwards) with the hammers towards you. Take off the damper wire buttons (or "pips") carefully, and at once place them into a small box. Take off the two nuts from the socket rail stays, and lift the socket rail from the wires. Remove the stays themselves, scratching T. or B. (treble or bass) upon them first. Put them and the nuts into the same box with the pips.

Turn the action over upon its back, but with the hammers still towards you. Then take out the hammer rest and the lever covering rail if there be one. This will expose the sticker hinges and stickers. Now with a sharp half-inch chisel clear the hinges from the hammer butts, steadying the hammers down with one hand. A very slight tap of the chisel when it reaches

the V of the hinge will suffice to bring away the short side of the hinge also from beneath the hammer butt. Having freed these all the way along, pick up each sticker and turn it straight out over the lever. This will bring the bottom ends cleanly away from the lever leather. If necessary, steady the lever to prevent breaking hinges; but if the stickers are turned over quite fairly and straight they will usually part easily. Place the stickers in order upon a board as they are removed and put them aside carefully for a while.

Any broken hammer shanks may now be repaired. Cut off the broken shafts quite flush to the head and the butt, showing the clear circle of the shank. With a proper shank centre-bit (and use no other) bore out the remains of the old shank from both holes, taking care to follow the lines of the butt both ways, and the line of the head also. Great care is necessary in the case of heads in oblique pianos to preserve the same angle into the head.

Fit the shank into the butt first, then lay the knife blade across the vacant space from head to head, and make a corresponding mark in the new shank. Take out the shank and cut it off nearly an eighth below the mark; unless, of course, this is a case where the shanks go right through the heads, when you would cut to the mark exactly. Cut the shanks by rolling them squarely under the edge of the knife blade. Put the hammer head on and re-insert shank in the butt. Make sure that the top of the head is quite level with the line of the other heads, filing the shank shorter as may be necessary. When that is quite correct take the shank out again. Roll each end lightly with a file, and with the corner of a chisel cut little channels lengthwise of the shank sufficiently long to clear the holes in head and butt. This allows any air to escape from beneath the shank end, and makes a better job all round.

Glue the head on, first twisting the shank round and round in the hole, in order to make a neat little collar of glue at the joint. Then glue the butt end of the shank and twist it into the butt to make a collar there also. Adjust the butt to the same line as its fellows; then adjust shank and head for level and spacing, and the thing is done.

This has taken more time to explain than the job itself would take; but if these little things are worth doing at all they are worth doing well.

Having repaired such shanks as may be broken, remove the old glue from the long face of the butts with a fairly smooth (but not too smooth) file. This not only cleans the butt, but tooth it for the new hinges. Be careful not to depart from the original flat of the butt, and also not to damage the corners or angles. Then with a sharp chisel clean the old glue from the short under side of the butt.

Remove the screws from the central wire plate and take the

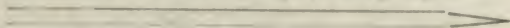


plate up. If it is in sections, number each section from the bass upwards. Put the screws into a box. Lift the hammers out and put them upon a board, being particularly careful not to bend the centre wire, which may be in sections or in one length.

Take the lever rail out and place it and the action rail out of harm's way for the present.

### RE-BUSHING HAMMER BUTTS.

Remove the hammers carefully from the wire, which should be held firmly at right angles to the butt, the hammer being drawn gently along and from the wire. Pick out one of the old bushings, and cut strips of bushing cloth the same width. Use nothing but the best scarlet bushing, which is made of a very firm, close texture. Cut each strip to a long angle,—so



Moisten these angles with a little thin glue, twisting them up into a long sharp point, which will lead readily through the holes in the butt. Cut a dozen of these strips for use. They should be of such width that when pulled firmly through the hole the cloth should line the hole completely and evenly. Strips for bushing are better *torn* carefully than cut with a knife.

Point your strips into the butts, and pull them through all but about an eighth of an inch. Touch the cloth that will be in the wood with thin glue, and pull the strip into proper position. If the bushing is exposed, as in many butts, take care that the join in the cloth is inside the butt and not seen. Run a wire somewhat smaller than the proper centre wire through the bushing to set it to the sides of the hole and put the butt down. Do a dozen butts at a time. Then come back to the first of the dozen, and with a sharp knife or chisel, and with a quick, firm stroke cut off the cloth quite flush with the sides of the butt. When they are all bushed, put them aside for a while to dry.

In many cases re bushing throughout is not really needed at all, a cure of the looseness being effected by the substitution of a new centre wire a gauge larger than the old one; but this must only be adopted when the bushing cloth is sound and good. When the cloth is really worn out, or has been attacked by moth, re-bushing is the only and proper remedy.

### RE-BUSHING SOCKET RAIL.

Pick out a pattern cloth from the rail, and tear a dozen strips to pattern, cutting long points to them as just described. Clean out the holes in the rail and paper up the rail itself.

The holes on the underside of the rail are countersunk. Enter the cloth from that side, pull it nearly through, touch it with glue, and pull it in flush with the countersink. Put in a dozen at a time, then cut them all off smooth and flush on the top side of the rail. The wires should run through the bushing quite easily, but with no shake.

### STICKERS.

The next stage demanding attention is the necessary cleaning and re-hinging of the stickers. First, with a pair of pliers pull out all the old hinges. If they were carefully removed from the hammer butts, the majority of them will pull out cleanly and easily enough; but some may be broken too short to reach with the pliers, and those will need lifting with a sixteenth chisel or a small awl.

Having removed the hinges, run a piece of glass-paper (folded on itself or over the edge of a scraper) through the grooves to clean and rough them. Then with the invaluable file clean the bottom end of the stickers, taking care to preserve the original bevel and to do no more than just remove the old glue, leaving a clean, toothed surface for the new glueing.


Next clean the damper wires carefully with fine emery or glass paper, but *do not* paper off the thread at the top which runs into the damper pips.

Tack a few sheets of No. 1 paper, and beside these a few sheets of No. 0, upon a flat board. Lay each sticker quite flat upon its face, and paper it clean, first upon No. 1, and finishing upon No. 0. Take great care to keep the face of the stickers quite flat and square, or they will never hang properly when the time comes. Follow round the bevel or curve at the top of the sticker, and replace them in order upon the board.

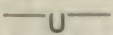
Look carefully at the hinge leather, which can be procured ready cut with the other material. Make sure that there is sufficient of it to go all the way along and that it is cut the right way of the skin. Leather stretches one way only, and in the case of a sticker hinge the stretch must be with the length of the strip and not with the width. If this is not so the hinges will be useless, because the leather will give when it is pulled up to the butts, and will drop the sticker right away from the butts before the piano has had a week's use. If you are cutting the strips yourself out of a whole skin make sure that you cut them the right way. These remarks apply with equal force to the lever leather and leather for pedal work.

In all cases the stretch should, of course, be *against* the grain, and not with it.

The leather should be of uniform thickness throughout the set (clean, sound and firm), and of such thickness as to quite fill

the hinge groove, yet to admit the use of the hinging tool without bursting out the top of the sticker. Never use poor, uneven, patchy leather. Now flog the strips against a clean piece of wood in order to remove the superfluous yellow dressing. Fold up the leather about so  making what will be the front side somewhat deeper than the back. As you fold it up, pass it over the end of the jack plane, and with a clean, smooth faced hammer tap the fold to fix it in the leather. Be careful not to bruise the leather with the edge of the hammer and tap it evenly all the way along.

Make two lines upon a cutting board somewhat (say, a sixteenth) wider apart than the width of the sticker, and with a sharp knife cut up the hinge into pieces of that width, keeping the pieces in order on the board as cut. Get the glue quite hot and in good condition; cut a hammer shank into a thin glueing stick and glue the groove in each sticker. Press the hinge in with the hinging tool (which is a thin piece of steel fitted in a wooden handle), keeping the long side of the hinge to the front of the sticker. Do not use too much glue, but use enough to coat both sides of the groove and to keep the hinge firm and steady. The very little superfluous glue will squeeze out in a little bead on each side of the sticker at the bottom of the hinge groove.

When these are all dry stand the stickers up on end upon the cutting board, splaying the hinges out in this manner:  
 Then with a very sharp knife and with clean, firm strokes trim the hinges cleanly off, parallel with the sides of the sticker.

Next mark off from the edge of a hardwood cutting block (the end of a jack plane is useful again for this) two lines showing the depth to which to cut the fronts and backs of the hinges respectively. When cut, the top edge of the hinge in the front should come within a sixteenth of the top of the flat on the butt, while the back portion should just fit in to the under level of the butt. Hold each sticker up to the angle of the cutting block, opening the hinge itself to the angle, and with the pressure of a very sharp three-quarter chisel cut off the front side of the hinge to the wider of the two marks. For this a chisel is much better than a knife.

Then turn the sticker over and cut the back of the hinge to the shorter mark, and with a bevel to it that will enable it to fit snugly into the angle underneath the hammer butt. Keep the hinges neat and square with the sticker, and make cuts firm and clean. Try a hinge or two upon the butts to make sure that the length both back and front is quite correct, and then cut all exactly alike.

A still quicker method is to remove the damper wires from the stickers first, placing them carefully in order on a board. Cut up the hinge in lengths sufficient to fill, say, six stickers;



and, holding the stickers quite close together, glue them up and hinge them six at a time, cutting the fronts and backs to the proper length to the marks on the block, then cutting the stickers apart afterwards. This is the way in which they are originally made. It wants practice and confidence, but presents no real difficulty. Clean damper wires and re-insert them.

### LEVERS: VELLUM HINGEING.

When the hinges throughout are in a weak and rotten condition the best course is to send one pattern lever to the action maker and get a new set to pattern, but if the majority of the hinges are good the odd broken ones may be repaired.

To mend a hinge remove the little block from the lever rail carefully with a chisel. Mind the chisel does not slip and break off seven more hinges in the process. Hold the little block firmly and with a vellum hinge saw cut out the old vellum. Now turn to the lever itself and (as a vellum saw is an awkward thing to start on a sharply bevelled edge) with a thin sharp knife cut down each side of the vellum and remove it. Most vellum hinged small work has a cross cut made in it just beyond the end of the hinge and nearly down to it. This permits a certain amount of "give" for the removal of old and the insertion of new vellum. If there are no such "cross cuts" make them with the vellum saw. Having removed the old vellum run a folded piece of glass paper through the groove.

Vellum hinges can be bought ready prepared, but a piece of old banjo head (if not too thick) or piece of legal parchment will answer equally well. Cut a piece about the size necessary, just long enough to fill both grooves, but allowing the bevelled end of the lever to come close up to the hinge block. *Rough this* with some glass paper or the edge of a knife, otherwise it will never stick. Coat one end of hinge with hot thin glue and insert it in lever first. Put it in a spring clip, or hold it for a few moments till it sets, then glue the other end of the vellum and put it into the block, taking care that lever and block are quite square and in line with each other. When dry or set, trim the vellum off flush and clean with both lever and block, all that should be seen being the smooth dark line of the vellum hinge itself. Clean old glue off the lever rail and replace the block, spacing carefully both at front and back.

### COVERING LEVERS.

Take off one of the lever leathers and cut or order a new set of exactly the same thickness. "Fawnskin" is used for sticker-hinges and "buff" for levers. Strip off all the old leather and clean off the old glue. Cut up the new leather into strips a little wider than the lever, because the pulling of them round

the lever will diminish them slightly in the middle. Do not forget about the real "stretch" of the leather being *against* the strain. Paper the blocks and tops of the levers clean; brush and blow out all dust and dirt. (A good bellows is an indispensable adjunct to a repairer, being absolutely necessary in the handling of action work and for many other purposes.)

Run a pencil gauge mark along the under side of the levers. Some levers have a little shoulder into which the end of the covering fits. Take lever rail out of the action frame and lay it on the bench, the tops of the levers flat on the bench. Glue the wood work only from the gauge mark to the cloth pad, which is beneath the covering; but do not put any glue on that pad. Fix the leathers all the way along on the under side only and let the glue dry. Now screw the lever rail to the front of bench, allowing the levers themselves to rest flat upon the bench; putting a strip of paper beneath them to prevent possible dirt. Run another pencil mark along the tops of the levers just about where the leather pulls over to. Glue the wood work from this mark to the point of lever and the front of lever; pull the leather up round the nose of the lever and clip it in position for a few moments with a spring clip.

(Handy spring clips for small work are made by screwing a few pedal springs to strips of wood about half an inch wide, in which the spring can be lifted and the work slipped under it.)

Having covered all the levers let them dry, trimming afterwards with a very sharp knife. In this case we have covered them upon the lever rail. The best and quickest method is to remove them from the rail first. If this is done care must be taken to restore the levers to their original positions and spaces. Before removing the levers run a small square along the lever rail and make a mark indicating the position of the left-hand corner of each hinge block. Take the levers off carefully. If necessary tap the chisel down the side of each block, otherwise pieces may be torn out of the lever rail in getting them off. Clean all old glue and dirt off the rail.

Levers can be covered better and quicker off the rail than on. Having removed all old glue and cleaned the levers, cut the buff strip up into lengths sufficient to cover six levers. Screw three or four pedal springs down to a long board for clips and cut pieces of wood about half an inch thick, one inch wide, and a little longer than the six levers are wide. Hold the levers close together top downwards, tap them into even line; run the glue along the six to the marks or shoulders as the case may be, put the leather into its place, put the wood slip in position to hold the leather down firmly, and slip the lot under the pedal spring clip. Do as many lots at a time as you can arrange springs for. When that is set, glue fronts and tops and fold the leather over evenly to the mark on top side of lever. Apply



the wood strip as before to keep the leather in position, and push the batch of levers under the springs, so as to still help draw the leather tight round the noses of the levers. When dry, cut the levers cleanly apart as in the case of the stickers.

When ready to re-hang the levers, screw the rail to the front of the bench as already suggested for "covering." Then screw the brass centre wire plate of this action on the bench itself just the length of the levers from the rail and in position corresponding to the spaces on the rail. Now glue the hinge blocks with the left-hand corners to the marks made on the rail, and adjust the noses of the levers to correspond exactly with the spaces in which the hammer butts go, as shown by the centre wire plate on the bench. This gives a little trouble, but it leaves nothing to chance or "rule of thumb," and it must of necessity come out correctly.

There are several patterns or levers. The treatment described has been that of common round nosed levers; but the exercise of a little judgment, ingenuity and common sense will suggest the treatment necessary for other patterns.

Again there may be circumstances and conditions under which it will be both better, cheaper and in the end more satisfactory to send away for a new set of levers altogether. No sane man repairs pianos for fun, and the course mentioned will in many cases prove quickest and cheapest, and show the most profit on that section of the work in hand. A really busy man cannot afford to spend half a day in time and several shillings in material to cover a set of weak, old levers that he could buy quite new for a little more and hang in half an hour. This is the really practical way of looking at the question. Every man should know how the thing is done and should be able to do it, if necessary, but there are times when the doing it oneself does not pay.

### REBUILDING THE ACTION.

Take the action frame all apart. Plane and paper up the standards and rails. Do not clean the hammer rest until later, because it will be handled repeatedly when taking the action in and out. Clean or replace all the rail screws, cloths and bushings about the frame. Replace the hammer rail, taking care that it is right side forward. Put in the hammer rest and stay rail. Stand up the action on the bench, placing a handscrew on the standard to steady it. Clean and give a coat of polish to the centre wire plate. Clean all the screw heads. Put the plate into position and just enter the screws all along. Put back the hammers carefully upon the centre wire in proper order, as marked. They should run on smoothly but firmly, and there must be no side shake whatever. The hammer when dropped should swing just once only. Take care that you do not push

out the bushings with the end of the centre wire. If bushing is tight, rough with a fine file a piece of wire a shade smaller than the centre wire you are using. Tap it into a piece of wood for a handle, and with this carefully broach out the hole in the cloth until the hammer will swing on the centre in the way described.

Get all the hammers on, commencing at one end, and be sure that is the right end. Space out the wire so that the ends of each section, where they meet, go halfway across the fork of centre plates, and that the forks when screwed down hold both ends firmly and securely. Space out the hammers to the forks. Drop the centre wire into the little groove cut for its reception in the wire plate and tighten down screws all along.

The rebushing of butts sometimes plays strange antics with the hammer spaces. When the action is originally made, the hammers are glued in to the butts as made, and to the original "lie" of them. Rebushing, however carefully done, has a tendency to alter the "lie" of the butts, and so upset the hammer spaces, making necessary considerable "casting" of shanks.

Replace the lever rail. Cover the bench with clean paper, and place the action (upon its back) flat upon the bench. Take out the hammer rest (which will expose the butts), and then proceed to hang the stickers. Place the board handy upon which the stickers lie, making sure that they are all in proper order. Have hot glue, stick, and proper sticker hook handy. Cut a wood slip about  $\frac{1}{4}$  in. by 1 in., and just long enough to go in between the standards. Wedge this in so that it will hold up the stickers from beneath in the proper position to bring the bottom ends correctly upon the levers. Try a few here and there. Fit the hinge to the butt, and make sure that the bottom end of the sticker falls correctly upon the lever and is supported by the slip. This will only answer with good and well made stickers which are true throughout, back and front. Failing this, glue in every tenth sticker throughout the set, fixing the hinges to the butts first, and then the bottom ends. Make sure that the ends are in correct position upon the levers, that the stickers themselves are perfectly square, and that a straight-edge will lie true along the lot. Then glue in the intervening stickers,—to the butts first, and then at the bottoms. Bring up each one square and true to a short straightedge held across the stickers already fixed. Firmly but gently press up the lever to the sticker for a moment until the glue sets, and pass along. Do not use too much glue, or it will squeeze out from under the hinge with the pressure of the hook in pulling the hinge up to the butt, and will mess up the lever, also preventing free action at bottom. In this operation the leather hinge has to be glued, as of course the butt cannot be glued satisfactorily. The glue must not be thick enough to chill before both ends of the sticker

can be secured, and must on no account be thin enough to soak into the leather of either the hinge or the lever top. Pull the hinges firmly, cleanly, and squarely up to the butts, and keep the whole of the work clear from extraneous glue.

Allow the hinges to dry. Stand up the action again upon the bench and press the hammers gently but firmly forward, which will stretch the hinges sufficiently to allow the hammers to drop freely and completely back upon the hammer rest. Clean the socket rail stays and replace them.

Turn the damper wires forward and down out of the way. Replace the hammer rest and place back the action into position in the case. Now look at the hammers to find how they space to the strings. If the hammer rail is a shifting one (for the soft pedal effect), it may be that a majority of the hammers are striking too far to the left. This shows that a little more felt packing is needed in the shoulder of the hammer rail, between it and the standard, to prevent the rail returning quite so far to the left. If the majority of the hammers strike too far to the right the packing must be reduced to bring the whole rail slightly to the left. The hammers must strike fairly and squarely upon the strings of each note. Having fairly restored the average, proceed to cast such hammers as may still not be striking properly. Use proper casting tongs and nothing else. Heat them just so hot that they will not discolour the shanks. Hold the shank quite firm and still and about one-third of the way up. Do not hold the tongs down upon the butt or the glue in the butt will be melted. Do not attempt to bend the shank with the tongs. Hold the shank firm and steady *with* the tongs, and bend only the upper part of the shank so much as is required with the other hand. Few people realise how amenable wood is to the influence of heat.

In the case of check actions, with separate butts to hammers and levers, a certain amount of spacing may be done by slightly altering these butts; but on no account destroy the actual spacing of the butts themselves, nor allow them to be at all out of square with the top of the hopper or sticker, otherwise the strain and friction will be all on one side of the notch in the hammer butt, or the lever centres will be wrung to pieces in course of time.

### THE DAMPERS.

Before going further let us look at the damper rail. If it is a rail that rests in a screw eye at the treble end and on the bass standard of the action at the bass end, place it in position and regulate the dampers as far as possible before turning up the damper wires, as better access can then be had to them. The front levers and the damper heads should all be in perfect line from end to end. The dampers must so rest on the strings that the pips will lift them quite clear of the string, but will



*not* jam the damper levers against the under side of the damper rail.

The pips must be quite clear below the damper levers, for otherwise they will hold off the dampers all the time ; and they must be so adjusted to the depth of touch that the dampers clear the strings but do not jam.

If the damper rail is quite independent of the standards one can of course get at it at any time. In the case of dampers with cloths and buttons, the top button should bring the damper to the strings, but must not lift the hammer from the rest. The bottom button must be so adjusted as to lift the damper just clear of the string. It is best to leave a certain amount of "play" between the under button and the damper lever, but not much. The damper must, of course, be off the string, even when the lever has dropped back upon the check, otherwise a note cannot be sustained.

Having made sure that the hammer rail is quite correct, and having cast the hammers, take off the hammer rest for a moment. Turn up the damper wires and replace the socket rail (which is already cleaned and bushed) over the wire and upon the two stays. Replace the hammer rest and space the damper wires clear between the hammers.

#### KEY SPACING.

Now have another look at the keys. Lay a straightedge along the heads and tap the balance pins right or left, as may be necessary to bring the heads quite square and parallel with the straightedge. With a proper key spacer, space the key in the front ; if the keys are good, the backs will be fairly right. If the backs are not straight, a sharp blow with a flat-faced hammer on the side of the keys, midway between balance hole and end of the key, will bend the key to some extent in the desired direction. Place the keys on the face of a flat iron fixed in the bench screw. Indifferent keys have a tendency to cast or wring at the balance hole. Sometimes the back half of the key, sometimes the front half, will incline right or left, as the case may be. Decide in which the fault lies. If in the back, make a long cut with a fine saw diagonally across the key on the under side, between the balance and the hopper, and and three parts of the way through. The cut should be made the reverse way to that to which the key is to be bent. Cut a long, thin feather-edged wedge of white wood veneer. Glue it with thin glue. Tap it into the sawcut until the key is forced into truth. Saw off the ends and plane sides and bottoms flush with the key. If the fault is in the front half of the key make the cut between the balance and the key head, cut and insert the wedge as described, which will bring the key head true again.

Provided that the levers have been properly hung, and that

the keys are now fairly spaced, the hoppers should naturally come exactly under the levers, and in continuation of the line of the stickers. It may be necessary to loosen old hoppers here and there and to glue them into the keys afresh, setting them exactly beneath their respective levers.

Having set up all the hoppers, turn them into their approximate positions beneath the levers by means of the little set-off eyes that project through the hoppers themselves. The top of the hopper should touch the underside of the lever in line with the bottom end of the sticker.

### LEVERS TO HOPPERS.

Now see how near the tops of the hoppers are to the under sides of the levers. If the new leather is exactly like the old there should not be much trouble.

The hammers must all be down true and level upon the rest. When in this position the top of the hopper should just touch the under side of the lever, but should not raise the hammer from the rest. Again strike an average. If the majority of the hoppers come short of the levers either drop the action to meet them or raise the back touch rail, the first course being generally preferable.

Many actions have a short screw under each standard, by means of which the raising or lowering may be effected. If the action has to be lifted from the hoppers, it is not much trouble to put two small screws into the standard blocks if there are none already. Otherwise pack up each end with paper or card, which is neither pretty nor workmanlike. If the action has to be dropped to the hoppers cut off a little too much from the bottom of each standard, and then raise the action to the proper height by means of the screws inserted in the standard blocks. If the upper part of the standard is doweled with the plank, we must shift the dowel to allow the action to move up or down.

Care must be taken that the action is not raised so much that the extreme treble hammers strike upon the pins in the upper bridge. Rather get the average of the hoppers a very little too long than anything too short. If the hoppers are raised by packing the touch rail, remember that the frame must be packed equally all over, or the depth of the touch will be entirely altered.

We will take it that the hoppers are now, some exactly right and the remainder just a little too long, raising the hammers a trifle off the rail. With a clean cutting file, take down the tops of the hoppers where necessary, sufficient to allow the hammer to just drop to the rest.

In check actions the stickers are set-up to the notches in the hammer butts, either by altering the screw beneath the cloth strip upon the end of the key, by altering a movable



button on the plunger rod beneath the lever, or by raising the screws of the carriage upon the key end. The sticker should just touch the notch, but must not hold the hammer off the rest.

Hold the hopper quite firm and steady, and be careful not to break the vellum hinge. Take care to preserve the original shape and character of the hopper top, and to keep it square in the front. When you have cut down the hoppers, paper quite smooth with fine paper. Mix a little finely powdered black lead to a smooth paste with very weak glue water. Keep the mixture in a saucer over the glue pot in order to keep it moist. With a small piece of hammer felt, or anything similar, coat the hopper tops with this, thinly but completely, and let it dry. Do not smear blacklead all over the hopper and the key. A little blacklead goes a very long way! When quite dry, burnish the tops with a clean bright marking awl.

### LAYING THE KEYS.

It is now necessary to decide upon the depth of touch; again strike an average, aided by the keys, the action and the hopper checks. In factories, where the same touch is always used, the regulators have little weighted blocks showing the exact depth required. The touch of modern pianos is much deeper than was used in days gone by. Having decided upon one key at each end which shall be as nearly as possible the same depth of touch as before, proceed to lay the keys.

If it be necessary to raise a head into line, put one or more thin papers (punched with the small centre punch) beneath the balance rail cloth. To lower a head, remove such papers (if any) or take a very thin shaving at a time from beneath the key at the balance hole with a small thumb plane. Level the keys up or down to a long straightedge (naturals first, and then sharps), until they are all in perfect line throughout.

If the key heads are quite level top and bottom, and the front rail is true, it follows that the touch should be of uniform depth throughout. This can be regulated by holding down two or three keys at a time and running a finger across them, when a sense of touch will indicate those too high or too low. Pack the low ones with cards or papers placed beneath the front baizes and substitute a thinner baize if necessary for those that are too high.

A touch may be made shallower throughout either by lowering the balance rail or by packing the front rail; it may be made deeper throughout by packing the balance rail or lowering the front rail.

Having arranged the depth of touch required and laid the keys accordingly, now proceed to set off the hammers. In a sticker action the hopper should carry the hammer up to within about an eighth of an inch of the string, and should then slip

forward and allow the nose of the lever to drop down to the check at the back of the hopper-fly. See that the hopper springs are strong enough, and that they are quite silent in their grooves. Adjust the set-off eye in each hopper so as to secure the escapement of the hammer in the manner described. The hammer must strike the string at the slightest touch of the key, but must on no account "block" against the string.

### ADJUSTING THE CHECKS.

Now adjust the checks so that when the key is right down the hammer falls back about half an inch from the string, and is also given a fair chance of repeating. There are several varieties of check, even in sticker actions. Some are simple wood blocks; others are wooden blocks capped with felt that may be cut down if necessary; while a third variety is adjustable, screwing up or down as may be required. A certain balance of adjustment may sometimes be made between altering the check and deepening or making shallower the touch; but, if the touch is correct and regular in the front, the proper course is to alter the check block in order to secure the same amount of drop from the string to all the hammers throughout. The escape of the hammer must be prompt and definite, and there must be no double impact against the string.

This having been done, take out the keys again, scrape and file the wood work and paper it smooth and clean both back and front. Blow out all dust and blacken about half an inch behind the sharps with lampblack and size. Wash the ivories and the sides of the naturals. Blow out the key bottom and restore the keys to the case. Clean the rails and replace them, and put the whole thing together.

### THE STICKERS.

In check actions the stickers will stick (a thing stickers should not do, in spite of their name) if the centres are at all tight, and will slap if the centres are at all loose. In some few actions, where the spring which connects up with the loop in the hammer butt is too close, the sticker knocks out against the spring each time it escapes, and makes a little clicking noise. To stop this noise glue a little thin strip of felt on the sticker at the point where it touches the spring.

In tape check actions centres sometimes tighten so that the spring (spiral or other) is ineffective. Ease the centre, which will rectify that. If the spring is broken make a new one as nearly as possible like the old one, taking care to use the same gauge wire and to coil it the same way as the other springs and to the same shape and strength. If you have to make a new set of springs throughout, lay a pattern spring upon a narrow

block, secured in the bench screw or fixed to the bench. Drive a panel pin or a beheaded wire nail through the coil of the spring, then one showing where the loop of the spring bends backward, and another quite close to it, round which to bend the loop itself. Go ahead, bending up the springs to the pins, getting them all alike. Spiral springs may be bought ready made.

Stickers will squeak or scroup if they need reburnishing top or bottom, or (in an action where the escapement button works on a rail behind the sticker) if the buttons need recovering or the rail upon which they work needs reburnishing.

### TAPE ACTIONS.

Modern tapes seldom go wrong except in the heads, which perish or cut out. The old leather tapes, however, were apt to perish throughout their length, and consequently break away. In the former case, new heads may be glued on to the original tapes, or new tapes altogether may be attached to a portion of the old ones. In the case of perished leather tapes, cut them right away. File a small flat upon the under side of the counter check shank. Cut all the tapes to one correct length and glue the ends to this flat; or cut the tapes to allow one eighth of an inch to fold over at the end, and then glue this fold to the hammer butt, with the angle of the fold up beneath the counter check shank. When originally made, the ends of the tapes are glued into the same hole with the shank of the counter check. A diagram of under and over damper tape check actions (combined) will be found on page 77.

### MOLINEUX AND COSTA ACTIONS.

In repairing these actions (a diagram of the Costa action will be found on page 76), the methods adopted are much the same as for the sticker action,—that is to say so far as the hinges, butt centres, and dampers are concerned; and, as there is little beyond these and the coverings of the checks to wear, it is needless to dwell further on the subject. In sticker actions, the butt centre usually consists of a wire running the whole length of the action, whilst in centre actions each movement has a separate pin or centre, these latter being pointed at one end to admit of their being more easily driven into their place.

Centre actions of all kinds are very liable to become sluggish in the centres: the cause most frequently being damp. In a case like this, the way is to draw the centre pins, using the same size pins when re-centring. The required freedom may be obtained in most cases by revolving the centre pin between the finger and thumb, and boring out a little of the red cloth with which the forks are bushed, using for this purpose the blunt end of the pin. The burr on the pin is quite sufficient to accomplish this.

The reason why a smaller centre pin should not be used in



this case is because it is absolutely necessary in all centre actions that the centre pins should be held firmly by the centre prong of the movement whilst it moves freely in the bushed fork. Thus, in speaking of a butt centre, the pin must fit tightly in the butt, whilst it moves freely in the clothed or bushed fork that carries the butt. Thus it will be seen that if a smaller pin is used, the repairer will be making trouble for himself; for, in obtaining the required freedom in the bushed fork, he has acquired movement where none is required,—namely, in the butt itself, the inevitable result being a noisy action.

Centre pins are supplied in sizes varying from Nos. 18 to 27 and half sizes (music wire gauge); but, if in doubt, send a piece of the original wire or centre, with instructions as to size.

If the centres in an action have become stiff through damp, it is a good plan to take out the action and place it near the fire for an hour or two. Cover the action meanwhile with a sheet of paper, so as not to let the parts come too close to the heat.

Loops in check actions are replaced by boring out the little plug from the back of the butt, cleaning the hole, re-inserting new cord, taking care that the loop lies at right angles to the springs on the sticker. Point up a new wedge, touch it lightly with glue, and plug the loop in as before, cutting all flush and clean with the back of the butt.

When re-looping an action throughout, take a pattern hammer and arrange a few nails or pins in a board so as to hold each hammer in the same position. Take another pin just the length of the loops from the butt. Having cleaned all the holes, place each hammer in turn in position on the board. Pass the loop cord through the butt and over the little pin showing the length. Pull the loop back to that length and plug it in. Thus all the loops are alike.

When replacing a broken spring, first remove the old spring. Cut off a small length of spring wire, pass it through the hole in front of the jack, and bend with pliers into the required shape, pressing well into the wood. Bend back parallel to the jack the piece of wire that is sticking out straight in front, cut to the required length and make a curve at the top to take the loop. Replace, and fasten the loop as before. Should the spring be too strong, bend more tightly to the jack; if, on the contrary, it should be too weak, open out from the jack.

It will be found best, in renewing felt, leather, baize or cloth to work as close to the original thickness as possible, which will save time and be more satisfactory. In this connection, repairers as a body are much indebted to the supply houses for catering for their needs in such an efficient manner. There is nothing a repairer requires which cannot be supplied. One firm issues a very useful pattern book of leather, skins, washers, felts and punchings, which is a boon to both dealer and repairer. By sending the number he can be supplied according to sample.

## UNSTRINGING.

**I**N restringing a case throughout, first loosen *all* the strings to tunelessness in order to relieve the tension evenly. Give every pin a half turn down. If the wire-gauge marks are not indicated on the wrest plank or bridge, carefully gauge one string of every note and prepare a list of the number of notes which go to each gauge of wire. If the pianoforte is an old one, restring with wire one gauge lighter than the original strings all through.

If the same covered strings are to be used again, remove them note by note and tie them up in order in loops made in a long stout piece of string. If new covered strings are to be used, get a piece of stout paper (white or brown) large enough to cover the area covered by the strings, reaching from hitch pins to top bridge. Secure the paper firmly, and then with a piece of heel-ball take an exact rubbing, showing hitch pins, bottom and top bridges, and pins. Send this off at once with the first and last of the covered strings to the string maker, who from the paper pattern and the strings will be able to tell exactly how to reproduce the set.

Take out the old listing and remove the steel strings carefully, taking pains not to scratch either the plank or the sound-board.

Remove all the wrest pins. If they are really firm and tight, get a new set of the same size; but, if they are the least doubtful, get the next size larger, even if a bit has to be run into the holes to secure a perfect fit. Brush and blow off all loose rust and dirt. Remove the pedal action and the key frame if necessary.

## A SPLIT BRIDGE.

**S**TRINGS and pins having been removed, a clear view is now had of the split top bridge. A bridge will split from being too heavily pinned in too straight a line, or if there is a sap streak in the wood. Bridges are better for some amount of curve, and should be made of clean, loosely flowered beech.

Decide how much of the bridge it will be necessary to remove in order to carry quite clear of the bad portion. Draw out all the bridge pins of that portion and make a fine saw cut straight through the bridge down to the plank in line with the draught line of the strings. *Take care not to touch the plank with the saw.* Prepare an exact rubbing of the bridge with a piece of stout paper and heel-ball, showing outside width, width



of bearing flat, bevel, and position of pin holes. Now with a sharp wide chisel lift the portion to be replaced, running a piece of card or veneer under the bevel of the chisel as it goes along, to prevent damaging the plank.

Having removed the bridge, cut off a piece showing thickness and send it with the rubbing to a pianoforte manufacturer, who will reproduce the new portion to pattern. There is not much difficulty in making it oneself, but it *is* difficult to obtain (outside a factory) beech good enough and fit for the purpose. The new piece will be returned blacked and varnished, with the pins just entered into the holes, but cut a little longer than the pattern, to allow of exact fitting into position.

Fit in the piece carefully, making a good joint with the remaining portion, following the old line on the plank. Scrape the portion of the plank covered by the bridge quite free from glue. It will be noticed that the new bridge has been properly "toothed" underneath.

Now bore between the string spaces, at intervals of two or three inches, holes to receive medium one inch screws; countersink carefully to allow the heads to drop just below bearing flat. Screw the bridge down in its proper position, to be certain that it is quite correct. Having made sure of that, remove it again. Warm the bridge slightly; glue it and the space it covers on the plank, quickly. Get it into position, screw it down to a perfectly close joint, run a sponge or brush round the joint to make it neat and clean, and that is done. Let it dry.

Then tap in the bridge pins until they project only about one-eighth of an inch and are fairly level. Now with a file rub them down until the tops are all flat and even, so /// /// /// /// and projecting about one-sixteenth of an inch only.

## GLUE AND GLUEING.

*[At this point it is well to remind the less experienced that the amateur idea that "the thicker the glue the stronger it will hold" is a very great mistake. Use only the best of glue, the best glue being made in Scotland. It should be used boiling hot always, and of such a thickness as to run like cream, quite freely and easily. Dirty glue, or that of the consistency of treacle is worse than useless, and will never make good joints or clean work. (The handiest thing for the outdoor tuner's bag is a tube of seccotine, which can be bought anywhere, is white and clean, and "sticketh closer than a brother." There is nothing better than good glue properly prepared.)]*

Wash the plank and sound-board carefully with a small sponge squeezed nearly dry. Clean countersinks of pin holes with sharp rose bit. Replace cloth on bottom bearing slip and bottom pin plate.

Before restringing, be quite sure that the plank and sound-board are in good condition, and that the bent-side and hitch plate are sound and not giving at all from the bracings.

## RESTRINGING.

HAVING noted or decided upon number of coils to be upon each pin in each row, coil the proper number upon the top pin. Hammer in the pin fairly well, pass the wire over the hitch pin, pull up quite taut with the pliers, and then cut off to proper length. Put the end into the pin, coil up till tight, and then hammer in. Adjust string to bridge pins on both the bridges. Hook up both coils compact and close. Pinch in the turn-in point close to the pin. Hammer both pins down to proper depth and level. (Some stringers leave the regulating of coils and pins till all the strings are on, but the difference is immaterial.)

The coils should be so arranged that when they are drawn up neat and close, and the pins hammered down level, the bottom coil should be a scant eighth of an inch from the plank; and all three lengths of steel (in a trichord) from bridge to pin should lie in the same horizontal plane. This will necessitate fewer coils upon the lower pins than will be needed upon the top row. When the strings are turned up the turn-in points should be underneath and unseen, in order to make a neat and workmanlike job.

To get the cut-off lengths for each row all alike, put the point of the pliers up to the pin-hole, and file in the handle three little marks at the proper distance above the pin-hole, at which mark the string can be cut off exactly every time, long or short, according to the row. Naturally, the thicker gauges of wire will want slightly less coil upon each pin.

Having replaced all the strings, get some amount of even tension upon them throughout. Then tap them down snugly to the hitch pins and upon bridges. Look over the pins and coils once more to make sure that they are all right. Next chip-up the strings to a whole note above pitch. When that is done, give them a good rubbing down to take out the stretch. Let them stand for a while, and then chip up again half a note above pitch, tuning each octave somewhat too sharp as the scale ascends.

Replace the listing or braid at the top and at the bottom; two rows at the bottom in order to prevent any possible vibration in that portion of the strings. Replace the pedal action, rebushing the sockets if necessary and greasing the springs. The case may now be stood up; and, if the work has been carefully done, the whole should look neat and sound.

Use *plated* steel wire which does not readily corrode and

costs very little more per case than plain steel ; and use *square* headed wrest pins. These may both be obtained of any good firm of pianoforte ironmongers.

## TOOLS.

*[A few words may be said here upon the subject of tools. A bad workman quarrels with his tools, but a good workman uses the best tools that he can possibly get and takes a pride in them. The best workman is helpless with bad tools, and particularly so in this business. A tuning hammer that wrings, a soft pair of stringing pliers or a screwdriver that crumples up are useless, and the purchase of them because they may be cheaper is the worst kind of folly. Go to a first-class tool maker and buy nothing but the best. Tools alone will not make a good workman ; but no good workman uses bad tools.]*

## THE WREST PLANK.

THIS is one of the most fertile sources of trouble. It frequently happens that the plank pulls off bodily from the bracings. There are also cases in which the plank is split from pin to pin ; and, again, where the plank is affected by rot or dote, thereby causing the wrest pins to run back.

Now, let us suppose that we have a case before us in which the plank has pulled off from the glueing. This is a job that should not be attempted at a customer's house. The instrument should be fetched away, and all the parts, action and keys, removed and put carefully aside. In most cases it will be found that the instrument is several notes below concert pitch, and that the plank appears to lean forward, and has parted from the capping. First remove the capping. This can easily be done by driving chisels, wedge shape, into the joint between the capping and the back. In doing this, the capping will, of course, be destroyed, but that cannot be helped. If it be a half-top instrument, remove the half-back as carefully as possible. After the capping is cleared away, the wrest plank joint will be exposed to view. This in most cases will be found to have pulled off from its glueing about a quarter of an inch. If, however, it is not off so much as this, either drive wedges in the joint or else tighten the strings so as to pull it off this distance, taking care, first, to turn out all screws and bolts that are holding it on. Next insert two pieces of wood in the joint to keep it open. Then slacken the strings right out until there is about one



coil on each pin. If the instrument is to be restrung with new wire, turn the strings right off the wrest pins. Now see that the joint is quite clean, and that no chips or shavings have fallen down into it.

Now give attention to the glue pot. This should contain at least one pint of thoroughly hot glue of the consistency of cream. The glue, when taken up on the brush, should run back into the pot smoothly. If it runs back clotted or lumpy, it is too thick: but if, on the other hand, it makes a dribbling sound like water, it is too thin. Now take two strips of wood about three-eighths of an inch thick and half an inch wide. Fasten one on each end of the joint with slight brads; that is to say, fix one on the top edge of the wrest plank, and the other on the top of the case. Let the slips run the whole length of the joint, thus forming a little gutter in which to run the glue.

Four or five good iron cramps will be required: about 15in. is a good useful size. Open these as far as possible. Some good stout blocks of wood on which to tighten the cramps are also necessary. Arrange these so as to fill up the space between the toes of the cramps and the face of the wrest plank, having a corresponding number for the back of the case. These last are to receive the screws of the cramps when tightened down. Now lay the cramps in a row on the floor, with the blocks required for each one beside it.

Having been able to proceed thus by yourself, it will be found of great service, if not absolutely necessary, to call in assistance.

Look round and make sure that everything necessary is ready. Lay the hammer ready to hand so as to knock a block or a cramp into position in case they slip. Close any window or door that admits any draught, so that the glue may not be chilled, and so on. Now take the glue and pour about half a pint of it into the joint, drawing the pot right along the whole length of it. The advantage of the slips of wood each side of the joint will now be seen, as they prevent the glue from running all over the top of the instrument. Whilst you are pouring in the glue, let the assistant work it well into the joint with a long table knife, previously dipped in boiling water to warm it.

Now pull out the wedges that are keeping the joint open. If five cramps are being used, put on the first one right in the centre of the plank, arranging the others at equal distances on each side of it. Let them reach in on to the plank as far as they will, but be sure to let them bite on perfectly square. The assistant should hold the toe of the cramp and block for it, whilst the workman tightens the screw and holds the corresponding block on the other side. There is no objection to the blocks being laid on the top of the wrest pins, as there is no danger of driving them in if the blocks are of fair size and thickness: say, 10in. long, 4in. wide, and 3in. thick.

When all the cramps are in position, give them one final tighten up, fetching out as much glue as possible. On a glueing of this description, the cramps should be left on for at least twelve hours; and, if there has been much difficulty in bringing up the plank to a good joint, twenty hours is not too long.

If the wrest plank, in coming off the glueing, has pulled down as well as forward, drive it up into its original position by means of struts jammed in underneath the bottom edge of the plank. Let this be done before you start glueing.

In a repair of this description, it is always advisable to put on the new capping "crossway,"—that is, the grain of the wood running from back to front of the instrument, as this binds the joint of the wrest plank far better than if it ran lengthways. The capping should not be put on till the day after the plank has been put back. Two hours will be long enough for the cramps to remain on this glueing. Take care in this case to have a board not less than one inch thick laid on the top of the capping. Place the cramping blocks on the top of this, and then tighten down the cramps as before.

In making the capping, let the wood be of the same thickness as the original. This must be cut in pieces *across* the board and jointed up,—if possible, overnight. When this has been done, glue a piece of strong linen over each joint. Before glueing on the capping, face over the side to be glued down with a fine sharp smoothing-plane. Be very careful in doing this, or the joints will break. Treat the top of the case in the same manner.

After having finished the glueings, turn in all the screws and bolts that have been removed from the plank, and tighten them well down. It is a good plan to add a few new screws to the number originally used. These should be about 4in. long, and care should be taken to let each of these go through the plank and into the bracings.

All that now remains to be done is to restring and tune the instrument. This, however, should not be done for three or four days, so as to give the glue time to get thoroughly hard before the strain is put on it.

In cases where the wrest plank is split or affected by dote or rot, the only sound way is to remove the old plank and put on a new one. There are two ways of doing this. The first is to drive off the plank bodily by inserting chisels in the joint, and prepare a new plank the same length, width and thickness of the old one. Next spring the top bridge carefully off the old plank. A good way of doing this is to chop through the veneer which covers the face of the plank with a chisel and mallet; then spring the veneer off the plank. This will, of course, fetch off the top bridge with the veneer. After the underside of the bridge is cleaned, it must be glued on to the new plank in *exactly* the same position that it occupied on the old. One can-

not be too particular in this matter. Then turn out the wrest pins, get a piece of white paper, and with a heel-ball rub a scale off, getting the exact position of every wrest-pin hole. Paste this on the wrest plank, but do not drill the holes until *after* the plank has been glued on, or else the holes will fill up again with glue.

### ANOTHER METHOD.

The second way of putting on a new plank is to turn out the pins as before, rub off the scale, then chop away the upper part of the plank from the capping down to the top bridge, clearing it right away down to the bracings. The advantage of this is that the bridge is not interfered with, or that portion of the plank below the bridge. Then proceed as before, making the new plank the exact thickness of the original, in this case shaping it so as to fit the top bridge. Glue on the plank, paste on the scale, and then drill it.

It will be found that putting on a new plank is a job far more difficult than merely glueing on the old one. In many cases it would pay better to let a pianoforte manufacturer make the new plank and also put on the bridge, leaving only the job of glueing it on the instrument and drilling it.

In glueing on a plank that has only come away from its glueing, the best position for the instrument is to remain on its castors; but in all cases where a new plank has to be put on, lay the instrument on its back across two trestles.

The best wood that can be used for a wrest plank is English beech. This should have the beet or flower on the face of the board. The beet consists of little silky streaks and specks running across the board in all directions, which can be more clearly seen when the board is fresh planed. The face of the plank should be covered with good stout veneer not less than an eighth of an inch in thickness. This, too, must cross the grain of the plank, or else it will be of little use.

Before taking off a wrest plank, make sure that there is something the matter with it. Cases are recalled where a wrest plank has been removed for a split when as a matter of fact it was only the veneer on the face that had cracked, the plank itself being as sound as the day that it was put on.

In all important glueings, the following hints are worth remembering. (1) Have everything that you require ready to hand before you start glueing, and let your movements be as rapid and quiet as possible. Do not bustle and run about. Also remember that all glueings should be done in as warm a place as possible. (2) Let the glue that is used be the best Scotch obtainable; also see that the water used is perfectly clean. Use a double pot in boiling it down, the outer one being used for water only. (4) In glueing two surfaces together, make one as hot as possible without burning it, whilst the other is being



glued. When the glueing is wanted to be very strong, glue both surfaces. (5) The general rule for making glue is to break up the cakes into small pieces, fill the pot with these, then add enough cold water to just cover them. This, when made, should be fair glue; but if not thick enough, add a little more cake glue.

## BENT-SIDES, BOTTOM PLATES, &c.

THE bent-side or belt of a piano is very liable, like the wrest plank, to pull off from its glueing. This is especially the case when the piano has been for some time in a damp place. The methods of reglueing on a bent-side are much the same as those adopted for the wrest plank, except that the instrument should be turned upside down, the capping or top of the instrument in this case resting on the floor. It will be seen that the glue will run more readily into the joint in this position than in any other: hence the reason for reversing the position of the instrument. But before this is done: all the movable parts of the piano must be put carefully aside, and the keys and action taken out, so that they may not be damaged. After this is done, turn out all screws and bolts that are holding the bent-side on. Then—as already directed in the previous article on the wrest plank—insert two wedges in the joint to keep it open. Next slacken out all the strings that are attached to the bent-side till they hang quite loose. There should not be the least tension on the strings whilst the bent side is being glued on, as this would seriously retard the power of the cramps when you tighten them up.

After the foregoing instructions have been carried out, turn the instrument upside down as directed. After having done this, take out the back lining and try on the cramps by passing them through the spaces between the bracings, and having blocks of wood of sufficient thickness to fill up the spaces between the face of the bent-side and the toes of the cramps, and a like number to go between the bracings and the screws of the cramps. After this has been done, pour into the joint some thoroughly hot glue. Do this with a table spoon; then work it well into the joint with a knife, both having been just previously dipped into hot water before using, to prevent chilling the glue. Then knock out the wedges and put on the cramps, and tighten them well down, fetching out all the glue that is possible. It should be the aim of the repairer to get on as many cramps as possible; but this in some cases is rather a difficult matter, owing to the smallness of the spaces between the bracings, and also the length of the bent-side blocks. It is always advisable to put in a few extra screws and bolts, which

should not be less than four inches in length. Get in as many of these as possible *directly* after the bent-side has been glued on, so as to assist the cramps in making a good glueing of it.

Bolts and screws are of great value in bent-side repairs, as it is often feasible to get in a stout bolt or screw when it is quite impossible to get on a cramp. This is especially the case at the extremities of the bent-side. As in the case of glueing on a wrest plank, the cramps should be allowed to remain not less than twelve hours, after which put in any screws or bolts that could not be got in when the bent-side was glued on. These must be tightened well down. It is far preferable to use a strong iron brace or stock and a screwdriver bit in turning in the screws than to use an ordinary screwdriver; this will exert a much greater pressure on the screw. It is also a good plan after the cramps come off the bent-side glueing to fit in a few stout blocks on the back of the bent-side wherever there is room. Any glue or dirt that may be on the bracings and the bent-side must be cleared away, so that the blocks may be quite close. These, if well fitted and glued to the bracings and belt, are a valuable support. They should be as large as the space to be occupied by them will allow. About three inches wide, three inches deep, and ten inches long will be about the average size. These also should be glued into their place by pressure, using either hand-screws or cramps for this purpose, as the case may require. Side pressure may be obtained by driving in wedges between the block and the bracing next to it. Three days should elapse before the instrument is brought up to concert pitch, the instrument not being sufficiently hard to resist the strain until that time has expired.

Bottom plates occasionally pull off from their bearings, though this is not so common an occurrence as for a bent-side or wrest plank to give way. There are two kinds of bottom plates in use, the first being a wrought iron plate, the front edge being turned over and supported by strong abutments let into the bracings. Defects in a bottom plate of this description are rare; but still there are instances where support is required. For a plate of this kind, the only practical way is to add one, or even two, abutments to the number already supporting the plate. These should be let into a bracing; but if this is not possible fill up the space between the bracings with a good stout block about a foot in length, glueing it well into its position, and strengthening it by means such as passing a strong screw or bolt through the bottom of the instrument into the block. Care must be taken in fitting this block to avoid its touching the soundboard or bars. The abutment should be let into the block before it is glued into position. After this is done, cut a hole into the sound board to allow the abutment to come through and catch the bottom plate; then glue in the block as already directed.

In letting in abutments, they should be made hot, and *glued* as well as screwed into their position. A little plaster of paris may be mixed with the glue for this work. It will be found that the cement thus formed will set very hard, and at the same time will fill up any unevenness of surface that may exist in either wood or iron. An abutment properly fitted and screwed in its position as above will take an immense strain, and often prove an effectual support to a weak plate. In letting an abutment into a bracing, it will be necessary to cut a much larger hole in the sound board, as the abutment will have to be let in from the *front*.

Cast iron bottom plates sometimes pull off from their bearings through being ineffectively bolted on in the first place. In this case, slacken the strings and take out the original bolts or screws one at a time, replacing them with bolts of the stoutest possible calibre. In cases where a cast iron bottom plate has broken in half it will be necessary to send the pieces to a good music smith to get one cast, and also to pin it the same as the original. This new plate, before being bolted on, should be bedded or fitted on to the bottom of the instrument; that is to say, if the plate bears hard on the wood in the centre whilst there is a space at each end, the wood must be planed away till it touches equally all over. If this precaution be neglected, the new plate is almost sure to break as the old one did. It is a good plan to bed all cast plates in plaster and glue as directed for the abutments. If the bottom plate be broken in more than two pieces, it is advisable to make a pattern for the new casting. This pattern should be the same thickness as the original plate, but should be about an eighth of an inch wider, and three eighths of an inch longer. This is to allow for shrinking. If these directions be observed, the new casting will be the same size as the original one.

## TONING.

IT is not advisable that the work of toning a piano should be completed at one sitting. If the instrument be given a preliminary toning one day and then left until the next it will be found to be a great help and much better results will be secured, as the ear comes fresh to the work and one is able to judge the tone better.

There are cheap felts which do not give good results when toned in the way described. When dealing with this class of material it is better to use a toner made in the shape of Fig. 3 and about three and a half inches long. Toner made of metal may be obtained; but a useful toner may be made of wood mahogany for preference. Two pieces of wood, with the needies



between, are glued together. Most people find a difficulty in arranging the needles parallel and properly spaced, but it can be managed quite easily in the following manner. Take a piece of fairly stiff paper and double it. Now pierce five holes about about a quarter of an inch from the fold (Fig. 4) and push in the needles; afterwards open out the paper (Fig. 5), when the needles will be found to be quite parallel. Turn over the end where the eyes are, when the points will be found to be quite level. The paper is then glued between the two pieces of wood and placed in a press to dry. If the needles are conveniently arranged in paper when bought it will not be necessary to follow the method described; all that will be required will be to cut off the number of needles desired and then glue them between the pieces of wood. If a toner is made in the way described there will be no difficulty in having the needles parallel and level at the points. The wood is finished off to shape after the glue is set.

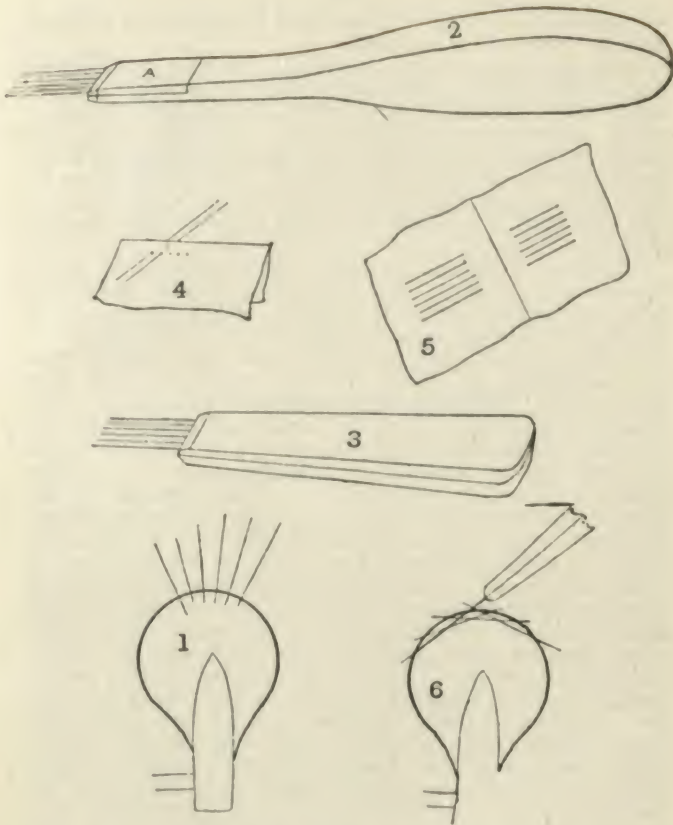
When using the short toner, the operations of glasspapering and brushing are dispensed with, mainly because the hammers are already in the pianoforte. It is not advisable to glasspaper the hammers unless they can be placed five or six at a time in a vice. In Fig. 6 is shown how this toner is used, the lines denoting the direction of the needles entering the felt. Take care not to probe too deeply, as this would impair the musical tone instead of improving it.

A fairly warm iron will restore some measure of brightness to hammers which have been overtuned; but, if this is resorted to, use it very gingerly. Nothing will, however, restore the felt to its original condition; and this is why the toning should be done by easy stages. It is better to undertone than to overtone; but the toning should not be considered finished if, when the keys are struck fairly hard, the hammers give out a clang. Where it is possible, it is a good plan to carefully try over pianos by leading firms—those who employ expert toners—and some idea will be gained of what is required.

Pianos may occasionally be met with in which the hammers had been recovered and never toned, although an instrument sent out in this state could hardly be regarded as finished.

Of course it is impossible for makers of cheaper class pianos to spend much time or trouble on toning, but such instruments would always pay for a certain amount of attention in this respect from the dealer or his staff.

One large manufacturer whose name is a household word has his hammers toned in the following way. Before the heads are fixed on the shanks they are placed, half a dozen at a time and side by side, in a small vice and are then glasspapered. To do this, take a sheet of No. 0 paper and fold it so that it is about an inch and a half wide. Now rub or file the hammer heads from each side towards the nose. The heads must be held quite



firmly together, so as to avoid any chance of their becoming rounded laterally. The next operation is to brush them with a very stiff nail brush. The reason for these proceedings is to remove any dressing that the felt may have had on the outer surface, and consequently to ensure that the pure felt comes in contact with the strings.

When the work of papering and brushing is finished, the hammers are placed in the piano and the toning proper is commenced. The hammers are stabbed with the needles (see Fig. 1), to facilitate which the "toner" is made fairly large—about six inches long—and fitted with five or six No. 7 needles. Fig. 2 shows such a toner; and it will be seen that at (A) is a remov-

able piece which may be heated and unglued so as to allow broken needles to be replaced.

Toning is begun at about middle C, this note being generally the first tested. The notes immediately on either side are next tried and toned, the work being continued until the whole of the hammers are sufficiently soft. The great thing is to secure an even tone; but careful work and considerable practice are necessary to bring about this result. It is better to tone all the hammers slightly at first and then to remove any irregularity; afterwards, if the piano will stand it, the hammers may be gone through again.

There are many young tuners in the trade who have a confused notion of toning. They have heard it spoken of in whispers by the head tuner or manager, who may have been unapproachable by the junior (for caste is sometimes found in music establishments), or he may have been too proud or too disinterested to enquire for an explanation. We have often seen in advertisements of pianofortes such terms as,—a beautiful liquid tone, a bird-like tone, a bell tone, a charming tone, an æsthetic tone, a tone with a soul in it, and many others. But how many of the ordinary public buy a piano for the tone qualities? They are influenced in a great measure by the exterior appearance and furnishing qualities of the instrument, though certainly there has been lately a tendency for the appreciation of tone, and makers are striving for the perfection of tone. There is more in the hammer in the matter of producing tone than some people will admit. I have seen pianos manufactured with the most scrupulous care as regards back, sound-board, case and action, yet spoiled, literally spoiled, by using a poor set of hammers. There is tone in wood, but you cannot tone the wood of hammers and get the same result as toning felt. Some people prefer a dulcimer tone, but most prefer a full round sonorous tone in the bass and tenor sections, with a flutey tone in the treble. Toning is necessary to make the tone of the hammers of equal quality; one may be hard, while the next may be soft. Of course there is always a tendency for a hammer to get harder with use, and for the felt to lose its resiliency by continuous impact on the strings. Good toning is an art which either makes or mars the beauty of tone in a piano, and there is as much difference in a piano well toned as there is in playing on a drum or an old tin can. Men have been asked how they toned the pianoforte? "Oh, I just put the needles through each hammer three times." This answer indicates quite plainly that they had not even grasped the rudiments, let alone the art of toning. They would have been surprised had they been told that some felt might require penetration by the needles ten, twenty or thirty times. A practised toner is able to tell by the feeling of the needles in the felt how much toning they will need until tried finally by the ear. It is



a matter of surprise that with the opportunities and facilities tuners have for practising toning, how few take any interest in the matter.

This is an art that may be acquired by keen observation and practice, and by the exercise of considerable patience and judgment. Much may be learned by testing the tone of pianos by the best makers. The ideal to strive for is the elimination of all harshness and the substitution of a mellow flutey-tone of musical quality. The bass hammers should be toned until there is absence of clang, and tone more like the tone of a muffled drum. There should be no twangy or stringy tone in the middle of the instrument, while nearer the treble it should be bright without harshness. In toning the supreme arbiter is that delicate piece of construction the human ear. We shall suppose that we have a new set of hammers in an action that had not been toned. We should try the tone in the various parts of the piano in order to hear how much toning would be necessary. We should lay the action on the bench. Now with a piece of No. 0 glass paper on a flat piece of wood about an inch wide rub lightly over the nose of hammers to remove any dressing there might be or hardness left from the use of the felt iron when shaping the hammers, and brush with felt brush to remove any grit or dust. Now with needles (No. 7 is a convenient size) start at the ball end and prick deep and often until the needles feel like entering a pincushion. This is difficult to describe, but practice will teach. After having treated, say, an octave in this way, put the action in piano and note the contrast to the notes higher. In this way go on by pricking a few, moving up the scale, and then trying action in the piano. It will soon be noticeable where there is one hammer harder than the rest; it is very little use just pricking on the surface of the felt, because a sharp blow or two would take this out. Try the note by striking gently, and if it is pleasing to the ear give a sharp blow or two, and see if it continues the same; if not, prick deeper. Brush over the felt again to remove any irregularities. Put the action in piano and see that the tone is smooth and of a regular gradation without one note asserting prominence over another. There is just need for a little caution; be careful not to overtone. This is where the need for judgment comes in. If a hammer is overtuned there is no resistance in the felt, and the result is that the hammer is spongy and hangs to the strings and does not give a clear sound. If by chance a hammer should be overtuned, place a damp cloth on the nose of hammer and with warm iron press gently, thus shrinking the felt. When dry, test the tone again.

## ON POLISHING.

IT has been well said that a piano well polished is half sold, and there are few who would cavil at the truism ; but it is a fact that one of the worst troubles with which the dealer has to contend is the obtaining and maintaining of that bright and smooth surface so beloved of the piano buyer. It is all very well for those who are in a position to keep a professional polisher, for their troubles will be narrowed down to seeing that the man does his work ; but to the dealer in a smaller way of business a real difficulty is presented in obtaining the services of a suitable polisher, and by this is meant a man who has been used to something better than varnishing furniture. Moreover, when a dealer is forced to fall back on the services of a polisher only casually employed there is the additional worry of not being able to secure the man when he is wanted.

Polishing is an art that can be mastered by most men if they are prepared to use a little judgment and to attend to a few important details.

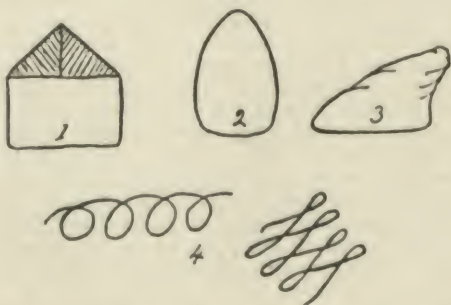
Let us therefore suppose that part of a piano has been cleaned off preparatory to repolishing. A scraper and glasspaper are mostly employed for this work ; but, after the use of these articles, the surface of the wood must be made perfectly smooth again, all scraper marks being rubbed out. Where only the surface of the polish has been marked by slight scratches the topcoating of polish may be removed by gentle rubbing with fine glasspaper upon which has been sprinkled some spirits, which will take off just sufficient polish to leave a clean smooth surface. To remove all the polish with glasspaper is a very dusty operation: for this reason many use a liquid polish remover (which is applied to the polish with a brush), simply wiping off the old polish with a rag and thereby leaving the surface of the veneer unmarked.

When the wood is quite clean and free from dust it will require filling in. There are several fillers, any of which may be employed for this purpose, the object being to fill the open grain of the wood in order to economise time and material. For those who need a filler only occasionally there is nothing better than one of the patent fillers, which can be mixed with turpentine or benzine in small quantities as required ; but for those who have a large amount of filling in to do and to whom cheapness is a consideration, a filler may be made by mixing methylated spirit and plaster of Paris. Tallow and plaster are used also ; but, on account of the grease being liable to penetrate through the polish and to cause sweating, this mixture is not to

be recommended. When using a filler made with plaster it must be coloured by the addition of brown umber if it is to be used for walnut or by rose-pink for rosewood. Rub across the grain of the wood when applying the filler, working the mixture well into the grain. Now wipe off the superfluous filler, and when dry use fine glasspaper in order to make the surface perfectly smooth, afterwards wiping over with a piece of wadding previously soaked in raw linseed oil and squeezed nearly dry. This latter operation is done in order to bring out the figure of the wood; but it must be borne in mind that any excess of oil under the polish is liable to cause sweating, for which reason many polishers omit the oil at this stage.

When the filler has been allowed to set, the first coating of polish may be applied. This is generally a mixture of brown hard varnish and polish (about two of polish to one of varnish), and it should be applied liberally with a piece of wadding, taking care to distribute the polish evenly over the surface without streaks (known technically as "whips").

The work must now stand for a day in order to allow the first coat to harden, when it may be rubbed down with fine glasspaper (No. 0) and a little linseed oil. When a perfectly smooth surface has been obtained, the polishing proper is begun.



To polish, a rubber is required; and it is a matter of some importance that the rubber be properly made. It will not do to wrap a handful of wadding in a piece of rag and expect to do good work with it. Obtain a piece of wadding about twelve inches square, and after removing the skin fold it twice, so that it is four inches square. Now soak the pad in methylated spirits, squeeze nearly dry and fold over two corners, as in Fig. 1. A piece of fine old calico rag is next placed on the wadding and twisted at the back until it assumes the shape shown in Fig. 2; and, when you have made a good rubber, keep it in an airtight tin, sprinkling it with spirits before putting it away, as an old



rubber is preferable to a new one. Remove the rag covering and apply a small quantity of polish to the wadding, afterwards folding over the rag carefully so that all ridges in the surface of the rubber may be avoided.

When first beginning to polish move the rubber along the whole length of the work, then across it, and next in circles and figures eight (Fig. 4), being careful to make each smear overlap the one preceding it. In a short time the rubber will drag and have a tendency to stick : when a little oil must be placed either on the work or upon the rubber, strict moderation being observed in the use of the oil. Most polishers have the oil in a small tin, into which they dip a finger and then touch the face of the rubber as often as is found necessary.

When one rubber has been applied and the work is just covered with a thin film of polish, the staining or colouring may be done. This work is necessary on account of the "sappy" parts appearing in the veneer, which must be made to match the darker parts of the wood. To make walnut colour, mix two tablespoonfuls of spirit, one of polish, a teaspoonful of gas black and a few grains of bismarck brown. Shake the mixture well, and after it has been allowed to stand a few minutes strain through muslin. Do not attempt to use the colour unless it has been so strained, or there will result a very rough surface due to the grains of bismarck brown which do not entirely dissolve. The various quantities of the ingredients are only approximate: more black would be required for a dark stain, while extra bismarck would give a warmer tone. To apply the colour use a camel hair mop (known as a gilder's mop) squeezed nearly dry. Paint over the light parts of the wood, being careful to follow the lines of the grain and going over each part several times in order to bring it to the required shade. It is better to have the stain rather light and to go over one part more than once rather than to have the colour of the right depth to begin with, as this latter method would leave the brush marks plainly showing.

When the process of matching up is finished and the stain has become thoroughly dry, go over the surface with an old piece of No. 0 glasspaper, moistened with oil. Do this very lightly, taking great care not to show scratches on the coloured portion. Now body up, giving the work three or four good rubbers and being careful to cover the whole surface, neglecting none of the corners or the awkward places. It has been stated that a polisher should take care of the edges and corners and leave the middle to take care of itself ; and, although this teaching must not be followed too literally, it gives an idea of the importance of seeing that every part of the work is evenly coated with polish. Keep a little pumice powder tied up in a muslin bag ; and, while bodying, dab the work occasionally with the pumice bag, the slight amount of powder thus deposited acting as a levelling agent.

If good work is required, the polish may be allowed to stand a week or more and then be bodied up again ; but in a factory, during the busy season, a day or less is considered time enough for polish to sink.

Finishing is the next process to be undertaken, and it is here that the skill of the polisher is tested most severely. The half-and-half rubber is now employed. As its name implies, this rubber is charged with half spirits and half polish ; but, to begin with, the amount of polish exceeds that of the spirits, the relative quantities being reversed as the work proceeds. A rubber made of old flannel is sometimes used for the half-and-half work ; but, whatever is used, it is important to observe that it is old material. A rubber that has been worked dry after bodying will do very well. It is necessary to use a little more oil at this stage of the work than was used when bodying ; but here again only enough to moisten the sole of the rubber, any excess being rigidly avoided.

In the final operation, spirits alone are used on a clean rubber. In working out the spirits, take long sweeps over the work, finishing by strokes in the direction of the grain of the wood.

Mouldings, turned work and so on cannot be polished by finishing ; so they are usually stiffed up,—i.e., a rubber fairly wet with polish is applied, the polish being allowed to set on the work before the rubber is passed over it again. No oil is used.

Glaze is sometimes used for mouldings and also for some other parts of pianos ; but its employment cannot be recommended, as it soon turns dull. Glaze is, however, extensively used and is easily distinguished by its peculiar smell and by the fine straight lines that show up so plainly in the sunlight. Glaze is always applied with a fairly moist rubber and in one direction ; no oil is used, the process resembling that for stiffing up.

Rosewood—perhaps the worst offender in the way of sweating—is polished in the same manner as described for walnut ; except that for colouring a mixture of bismarck brown (two parts), dragon's blood (one part) and red sanders (one part) is used. This stain may be put into the polish which is to be used for bodying ; and, when the work is dark enough, a rubber charged with ordinary polish may be employed to finish the body. White or transparent polish may be used for finishing off.

Ebony and its imitations are stained before being filled in, black polish being employed in the bodying and white polish for finishing. Black polish is made by adding spirit black to ordinary polish and white polish is made by using bleached shellac.

One of the most troublesome things in connection with rosewood is its liability to "check," which is quite a different thing

to sweating, as the surface becomes very rough and the open pores of the wood show very plainly. The cause of the trouble is generally thought to be excessive dampness, while others aver that it is on account of acid in the wood; but, whatever the cause, the only satisfactory way of dealing with it is to rub down and repolish.

Marqueterie work and any inlaying is scraped after the main portion of the work has been coloured; it is useless to try to paint round the marqueterie.

Bruises and indentations may be dealt with in the following ways. Many polishers make a few small holes with a bradawl or similar instrument, melting in some shellac with a hot iron; but, owing to the shellac having a liability to chip, a "stopping" is recommended. This material can be bought in sticks or it may be easily made. Take about half a teacupful of shellac, a piece of beeswax the size of a filbert nut and about the same quantity of resin. Melt all together with a gentle heat and add a little yellow ochre, which will make a light-coloured stopping. Take a small quantity and roll it into a stick. Now add brown umber; and when a stick has been made of this shade, add some bismarck to give a rosewood colour.

The stopping is melted into the bruise with a warm iron, levelled off with a sharp chisel and then papered smooth. For a bruise not of a serious nature, the brown paper treatment is often successful. The wet paper is laid on the bruised portion and a hot iron brought near to it; but the iron must not be too hot or it will blister the polish and the iron must not be allowed to touch the paper.

While in French polishing we are careful to apply all the polish with a rubber, in the German method the brush figures prominently; indeed, German polishing is very similar to carriage polishing, except in the final stages. The wood is first filled in with a coloured filler to match the wood; and, after this has set and been levelled, the staining is done before any varnish is applied. Again employ the fine glasspaper to take off any unevenness left by the stain and afterwards apply a coat of good copal varnish. The varnishing should always be done in a warm room and the work given a horizontal position whenever possible. Leave the varnish to dry thoroughly and harden; this takes from three to five days, and on no account attempt any levelling of the surface until assured that the varnish is quite hard. With a felt pounce and some pumice powder and water the surface is gently rubbed with a circular movement until it is dull all over. Where any bright parts show after rubbing with the pumice there are hollows, which must be attended to, and if necessary given an extra coat of varnish. But if the ground work and cleaning up has been well done there is little likelihood of any trouble from this cause.

When the surface is dull clean off all the white marks left by



pumice powder, so that when the work is quite dry there is no suggestion of whitewash about it. This is important, as the white smears will show through all the varnish and will spoil the work. In such cases the proper treatment is to apply some paraffin to the parts and leave it to stand over night and next morning the marks will be found to have disappeared, when the oil may be cleaned off; or, alternatively, a rubber charged with polish (one part) and spirits (three parts) may be used on the surface of the polish with some linseed oil as lubricant. This will be found effective in getting rid of the white patches for some time, but they are liable to reappear in the future; hence the importance of cleaning each surface thoroughly.

Another coat of varnish may now be applied and be allowed to harden like the first coat. Three or four coats should be given, each one having time allowed for hardening and being carefully rubbed down; the last coat with very fine pumice powder and oil. The work is now ready for finishing, and if this is carefully done a beautiful level surface will result.

Polish with white polish, using pumice pounce at first to keep the work smooth, proceeding in the ordinary way with half-and-half rubber, using plenty of oil; or, to be more accurate, slightly more than is used in French polishing. Some polishers use white poppy oil, but good linseed oil will be found quite suitable and is preferred by the majority. When every trace of a polish smear has been worked out, wipe lightly with fine calico moistened with spirits in order to remove most of the oil and afterwards wash the work with sulphuric acid 'solution (one part of acid to seven parts of water). A calico bag filled with Vienna chalk is next dabbed on the surface, and the final polish is secured by working the fingers or the palm of the hand on the chalk until a bright finish results. A pad of chamois may be used if one is not blessed with a soft hand.

In order to economise in time, spirit varnish is often used for filling in and for bodying; but, although a bright surface is obtained, it is not nearly so durable as that possible on a copal varnished body. The spirit varnish, often very resinous, shows a white mark immediately anything comes in contact with it; and, if it is composed of materials of inferior quality, the varnish soon shows innumerable cracks. Whatever varnish or polish is used in the pianoforte warehouse, eschew the varnish stain; plain French polish, composed of shellac and spirit, is far superior to any mixture coloured to imitate an impossible wood. If any colouring has to be done, do it first with stain as before mentioned and then proceed to varnish.

If a bloom appears on the surface of polished or of varnished work, this is due to the presence of water either in the spirit or in the varnish. It pays to buy the spirit from a firm equipped with the necessary plant for producing the same; local dealers frequently supply spirit which is suitable only for burning.

## REGULATING UPRIGHT AND GRAND ACTIONS.

### AT THE FACTORY.

**I**N order the more fully to understand what regulating is, we will endeavour to follow the routine observed by a regulator when at work in the factory on a tape check action. After removing the action, he will with a fine key-file, wedge or pliers, ease carefully all the keys; also tightening those which are too loose by turning the bat pins a shade with a key spacer. The next process is to remove the damper rail and stand the action upright on the bench, where the length of the tapes is regulated, an eighth of an inch play being left between the top of the jack and the notch of the hammer, to facilitate repetition or quick recovery of the jack under the notch. The action is then placed back in the piano and the pilot screws at the back of the keys turned up. The hammers should lie even on the rest. When the hammer rest is pulled forward slightly, if there is any lost motion, the hammers will show it by dropping out of line. If they are correct, when the finger is passed along the back of the keys, there should be a slight movement of the hammers towards the rail; or, in other words, be hard on the keys. If this is not left so, when the tuner has done his work the piano would show signs of lost motion or beating up.

The correct depth of touch will next be verified by placing the thumb on a key and pressing the hammer gently towards the strings in several places along the keyboard. If the hammer does not reach the strings, the touch will be too shallow and will probably need a piece of brown paper or card under the balance rail. If when the hammer goes to the string there is a feeling that the key is not resting on the front baize, the touch will be too deep, and a card under the front rail is necessary. By putting paper washers on the top of the front baize until the required depth is obtained, the workman can ascertain the exact thickness of card necessary. He will then level the tops of the keys to a straight-edge, removing a thin shaving from the high keys and placing a paper washer under the low ones. Should they happen to be out of square, the regulator will tap the balance pin right or left as the case may be. With the key spacer he will regulate the space

between each key uniformly, also spacing the sharps both at the front and on the balance rail. It will be necessary to see that the hammers strike the strings evenly and squarely, any inequalities being remedied with the tongs.

Proceeding, the regulator turns the set-off buttons until the hammers reach within three-sixteenths of an inch to the strings and the jacks escape from under the notch of the hammer. Then he regulates the checks to catch the hammers after escapement three-eighths of an inch from the string. Any irregularity in the depth of a key is remedied with a paper washer, or sometimes by hammering the baize to compress it to make it deeper.

Having gone through all the keys, the regulator replaces the damper rail, seeing that the damper lifts the proper distance from the strings and that the damper wires are free.

It is urged that the procedure here detailed is the usual way of regulating, though slight variations may be followed by different firms. No standard touch exists, and pianos by different makers will be found to vary in depth of touch, weight of keys, in the balance of the key and the point of contact with the action, the blow of the hammer, and particularly in the skill of the regulators. Finishers work to rules and measurements laid down by the manufacturer, and these are presumably those which in his opinion secure the best possible touch and at the same time impart an individuality to his instruments.

### THE UPRIGHT.

A TOUCH at once light and firm and allowing the keys to descend three-eighths of an inch, with quick repetition: this is the ideal for a check action. Only a small percentage, unfortunately, of the actions designated check ever attain to this ideal; and many which are turned out new in excellent working order very soon deteriorate and show marked defects. There is one thing which is never to be found in a cheap or a badly set up action, and that is a smooth touch. By this is meant a touch which is perfectly free from little jerks and resistances, small in themselves yet so detrimental to the proper rendering of any composition. On examining a tape check action (with overdampers), it will be observed that the portion first to receive the upward motion imparted by the key is hinged or pivoted very near to one end, so that by its own weight it rests on the key. This is the jack rocker; and it is usually made so that the key bears upon a projection somewhat more than half the distance from back to front.



Passing through the front end is the damper wire, which is lifted simultaneously with the jack; or, in the case of a badly made action, the damper is lifted when the key is nearly at the end of its movement. This is one of the great defects to be found in many check actions. The damper wires must be turned up or the dampers would be held tight against the damper rail, while the damper rails would prevent the jack rockers from rising; the consequence is that one notices two distinct weights in the touch, one when the jack begins to rise and another when the jack rocker comes into contact with and lifts the damper wire.

Now, a moment's consideration will show that a little alteration in the position of the point upon which the key is made to bear, or a slight drop in the back end of the jack rocker, would correct this fault; yet many hundreds of actions are turned out every year with this unpleasant double touch. There are two ways in which a touch is made heavy; one is the weight of the keys and actions and the other is the resistance occasioned by the bad angles and leverage of the different parts of the action. To take a very simple action as an illustration of our meaning, there is the "Costa" action. In this action, which follows on the lines of Molineux, a sticker stands up from the key and rests in the notch on the hammer butt. If this sticker should be placed in a perfectly upright position, it would scarcely require the intervention of a set-off in order to dislodge it from the notch and provide an escapement, while the resultant touch would be light and the reverse of firm. Therefore, in order to give some resistance to the touch and at the same time to ensure that the propelling force shall not leave the hammer until forced away by the set-off, the sticker is set at an angle so that instead of travelling in an upright direction it inclines towards the strings of the piano.

From this brief statement of the case, it will be very plain that any exaggeration of the angle at which the sticker inclines will produce a bad touch and will also quickly wear out the cloth in the notches. From this it will be seen that one of the essentials of a good action is that whatever is employed in the notch to force the hammer to come into contact with the strings must remain firm under the hammer until the latter is quite close to the string while at the same time a very light touch of the set-off button should be sufficient to remove the sticker or jack at the critical moment. Owing to badly designed notches, it is no uncommon occurrence to find a pronounced jerk when the set-off button is called upon to perform its work.

In an underdamper action, the springs of the dampers are,

sometimes too strong and the spoons which operate the dampers are bent too far back, when most of the unpleasantness already remarked upon in the overdamper action makes itself apparent. It is quite useless to attempt to produce a good touch in any action which has become worn; and especially is this so when the notches are so hollowed out that they are twice their original depth. These must be attended to first and afterwards the keys must be levelled, the tapes in the action adjusted and all unnecessary space between the different parts eliminated. These adjustments come under the head of regulating and are similar in effect to regulating the action in a grand pianoforte. Now in order to allow of a second blow being given before the key has been allowed to rise fully, the hammer—instead of falling upon the hammer rests after hitting the strings—is caught by the check and held in position for repeating a note, so we thus have the term repetition action. The check will fail in its duty if it is bent so far back that the hammer almost falls upon the rest; on the other hand, the touch will be spoilt if the checks are too close to the balance hammers and have a tendency to push the hammers on the string.

The tape action is the most popular for upright pianos. When thoroughly regulated and good material used, this action wears well and gives the minimum of trouble. It is important and necessary when repairing a tape action to see that the leather on the notches and checks, the felt and cloth on the keys, and the baize and punchings, are of the same thickness and quality as the original. The new felt on the hammers should also be of the original thickness. These precautions will save a lot of trouble. Re-centring and occasionally rebushing are often necessary in a thorough repair. Springs may be corroded and need renewal.

These remarks also apply to the underdamper action.

The sticker action is obsolete. The Costa, a simple check action, has long been used in its stead. It will, however, be many years before the last sticker action has disappeared; therefore it is always possible to buy parts for this action—hammer rails, levers, stickers and dampers—through any supply house. When thoroughly repaired and well regulated, the sticker action should be satisfactory, and repairers should keep in touch with it.

The Costa action is a spring and loop action, upright stickers moving between guide pins, and formerly with a pin and button moving on a bevelled slide rail to set off the hammer. This slide rail has now disappeared, and a front set-off button in a front rail is used instead and is more satisfactory. A few remarks on this

action as regards regulating are necessary. Take away the damper rail and front set-off rail, unhook springs, blacklead stickers top and bottom, see that the strips of cloth on the sides of the stickers are intact and that the leather on notches, balance, hammers and checks are in good condition. Now loop up the springs and see that the pilot cloth on the keys is in good condition. Turn up the pilot screw until there is no play between the top of the sticker and the notch of the hammer. The stickers must move freely between the guide pins and the keys should work freely but not too loosely. Level up the keys with paper punchings or washers. Put on the set-off rail and then see that the touch is deep enough to carry the hammers to within an eighth of an inch of the string. If it does not do so and there is touch or space between the key and front baize, this space must be made up by putting card under the front rail of the key frame. If it does not then carry up, make the touch deeper by putting card under the middle or balance rail. Now with a set-off tool turn the buttons on the set-off rail so that the stickers escape when the hammers are the proper distance from the strings. With a check-bending tool regulate the checks so that the hammers fall in check when three-eighths of an inch from the string. See that the bushing for the damper wires in the stickers is in order. The damper rail may now be replaced; it may require a little adjustment, moving a little nearer the strings to compensate for sinking. See that the damper lift-rail moves the dampers evenly and that the wire lifts the dampers so that it barely touches the rail.

A Molineux action may be met with, and it will be found similar to the Costa, with the exception that it has a brass screw through the top of the sticker which sets-off on the back of the hammer butt. It was the pioneer of the spring and loop variety of action.

### THE GRAND.

We may now pass on to a consideration of the grand action and its regulation. In the state of perfection in which we find it to-day, the horizontal (or grand) action is perhaps the finest piano-forte action ever made. If properly regulated, it is capable of giving the very finest shades of expression; and it has the not inconsiderable advantage of remaining in good order, once that state has been reached, for an indefinite period.

Grand actions may be roughly divided into two classes,—the single and the double escapement actions. The single are rapidly becoming out of date, being superseded by the double escapement



action, which is now generally admitted to be superior for brilliant execution. In the single escapement grand action made for many years by the house of Broadwood there is hinged on the key a hopper, which imparts to the hammer its upward motion and at the same time comes into contact with a set-off button. The hopper is returned under the hammer notch by means of a spring. This action gives a firm even touch and is much favoured by pianists, but, in order to provide for proper repetition, care must be taken to see that a very small space is left between the top of the hopper and the notch when the hammer is at rest. It should be possible to insert a piece of thin card between the hopper and the notch. This piece is known as "card" and without it the hopper is liable to be caught outside the notch and so to fail to strike.

Now, in the case of the double escapement action this space is not needed, owing to the fact that the action provides its "card" space in the second escapement. If we look at almost any grand action, we shall observe that on the key being depressed the hammer is raised and the set-off button causes the hopper to escape from under the roller; immediately afterwards, a small screw in the hammer flange comes into contact with the repetition lever (upon which the roller rests) and so produces the second escapement, allowing the hopper to regain its position under the roller, even though the key has been released but a little way.

Coming now to practical matters, we will suppose that a grand piano has been somewhat neglected and requires regulating; we are therefore starting at the beginning. The first essential, then, is to remove the action and keys from the piano. This can be accomplished by turning out either thumb screws or ordinary screws, which will be found under the key-bed. The key blocks and front slip will now be free and may be removed, after which the action may be drawn forward and lifted clear of the piano. (Usually the fall over the keys is removed before the key-blocks, but in some instances the fall and key-blocks are connected and come out together.)

A word of caution is necessary at this point. So many hammers are broken by tuners and others carelessly pulling forward the action and omitting to notice whether any of the hammers are off the rest, either damaged through damp or any other cause. It is, too, a frequent practice with some tuners to allow their coat sleeves to touch the keys, with the result that hammers are broken and other damage is done. This is very trying in the case of hammers which have forked shanks,—i.e., where hammer stems are divided and the head of the hammer is glued between the

prongs of the fork, so that they are not easily replaced. Should one of these shanks be broken and provided there is no room on either side it may be repaired by glueing a thin strip of wood on each side, binding them with thread until the glue sets and afterwards paring them down to a sixteenth of an inch in thickness (or less if necessary). If the break is too bad to repair, a new shank may be obtained and fitted; but a little care here will save a great deal of trouble.

To regulate properly a grand action, one thing is essential and that is a level surface. It will not do to place the action anywhere that may be handy and then expect it to be quite right when it is replaced in the instrument. If a good table is not available, a portion of the floor will sometimes answer to the requirements or even the top of the grand itself; but if this is used beware of scratches on the polish. The whole idea of regulating is first to ensure regularity and secondly to bring the action to the highest point of efficiency, both as regards delicacy of touch and capability of rapid execution. This being so, every part of the action which has to do with the movement of the hammer must be made to work quite freely and yet without the slightest tendency to wobble. On each note of the action, there are at least four (and often more) centre pins working in cloth bushings, each one fitted to a nicety and contributing its share either to make or to mar the repeating qualities of the note. Centre pins which are too loose or too tight should be replaced by new ones: this requires much practice and carefulness to do with any degree of success, but the action cannot be regulated while the centre pins require attention. The keys, too, sometimes become tight, perhaps not sufficiently so to stick down but quite tight enough to spoil the touch. Before we can attend to the keys, however, the action must be disconnected from them. In most cases, this simply means that a few screws will require withdrawing; but in some instances there will be found a sticker or lifter coupling the action to each key. To disconnect these, loosen the screws to be found in them and give a gentle pull, when the keys and action will be found to separate. It is necessary to release all the keys before attempting to take off the action. The beam on which the hammers are screwed will sometimes require to be taken off; and when this is being done take the wise precaution of lifting up the hammers so that they remain in an upright position, otherwise some of them will surely be broken.

The action having now been removed, the keys may be lifted off separately and eased or tightened as may be required; in the

former case the stem of a tuning fork may be used to press back the bushing, while in the latter case the oval pins in the front of the key frame may be turned at an angle. Should the centre of the key be loose a larger key pin may be fitted or the key rebushed. All the keys should be made level by placing paper punchings under the cloth washers on the centre or balance rail of the key-frame, and so raising the fronts of low keys. A straightedge will be of much use in showing up irregularities, but of course if such a valuable tool is not handy we must trust to a good eye.

When the action is replaced on the key-frame, the next step is to see that no lost motion occurs, or in other words that the key commences to lift the hammer immediately the key is lightly depressed; and we must also observe that no hammers are lifted off the rest. Here again it will be well to mention the "card" room necessary in the single escapement actions. If there is any space to be made up, it may be done by turning the screw studs, which will be found fitted in the keys; and if the studs are not in evidence some other arrangements will be found in place of them, such as rockers or screws. When altering a rocker, be careful to turn both screws in it or the rocker will become loose and rattle. The secret of fine regulating is to endeavour to keep the jack under the roller as much as possible,—that is to say, if the jack is forced from under the roller but slightly and the check holds the hammer in position ready for the next blow there is every reason to expect good repetition.

In endeavouring to bend the checks so that the hammers are not allowed to fall too far, be careful not to overdo this or the hammers will catch on the checks before reaching the strings. Many tuners have been puzzled to know why some hammers would not strike when the fact that they were catching on the checks had been overlooked.

The set-off may be regulated when the action has been replaced in the piano. If a key is depressed the hammer will be forced up to the string and instantly fall back upon the check; and when the hammer refuses to return promptly but instead clings to the string, the disagreeable result known as "blocking" is to be heard. This is remedied by turning down the set-off button, which acts upon the jack. Regulate the set-off to act when the hammer is about one eighth of an inch from the strings. A light blow imparted to the key should be sufficient to enable the hammer to fall back and the set-off must be turned to effect this; but, with this in view, the closer the hammer is brought to the string the better. After the hammer has fallen, the key should be bedded firmly on



the pad beneath; it should not be possible to depress the key further after the set-off has done its work. The depth of touch should be between three-eighths and seven-sixteenths of an inch: certainly no less than the former figure, save and except it is in a very old grand.

Thin card washers on the centre rail of the key-frame will deepen the touch; while to effect the reverse, place card washers under the front baize washers (the sliding key-frame prevents the expedient of placing a few pieces of card under the key-frame, which would be done in the case of an upright piano.)

In order to determine the correct depth of touch which will suit the action, the set-off buttons must be turned up so that the hammers will block. If the touch is too shallow, the jack will fail to carry the hammer up to the string; while, if the reverse is the case, the hammer will be forced against the string and will still leave a feeling of springiness under the key. It will be found in practice that the repetition screw rarely requires turning; and, should it do so, a matter of half a turn will be found ample to effect the necessary "card." If the action has been turned out of the factory in good order, the repetition screws will not require turning up at all, the slight regulation that may be necessary in the other direction being simply to take the bearing which may be lost through the leather on the repetition lever having become beaten down in the course of wear.

The dampers are mostly weighted in the lever to which they are attached. They are liable to stick through the wire becoming tight in the bushing; and they should be eased by passing in a steel point, such as a marking awl, and so opening the bushed hole. In a few makes the dampers are placed under the strings and are held up by springs. These dampers will, however, be found to give little trouble; the fault to which they are most liable is that of becoming hard, partly no doubt because of the fact that the felt is face upwards and becomes filled with an accumulation of dust. In this case soften with toning needles. The key-board of the grand piano being moved to the right when the soft pedal is used frequently causes an uneven wearing of the hammers and too frequent use of this pedal is therefore to be deprecated; the diminution in tone should be obtained by a lighter touch upon the keys. The sliding key-board is sometimes responsible for quite another trouble,—namely, that of the dampers lifting off when the soft pedal is used. This occurs only when the damper levers are too close to the keys and the cloth upon the levers has become worn or pressed in at one side, so that as the keys move along and

bear upon a comparatively unused portion of the pad the dampers are lifted. The remedy is to turn in the damper wires.

The action and key-board are liable to work forward and thereby cause some of the hammers to catch on the wrest plank and to stick. Frequently, the hammers will just touch the wrest plank, not with enough pressure to cause them to stick but sufficiently to arrest their force upon the string, with consequent loss of tone.

Hammers, too, which have had some amount of hard wear become flattened at the nose with a consequent spreading out at the sides; and this is also a cause of the hammers coming into contact with the wrest plank or sound board. The hammers may be pointed by rubbing them with fine glasspaper: or, what would be better, they may be recovered.

In the case of an action which works forward and is not provided with means for setting it back, it is advisable to glue two or three small pieces of hard wood on the front of the key-frame, blackleading these to reduce friction.

Finally, see that throughout the whole compass of the instrument regularity prevails and that every part of the action does its appointed work at the right moment.

## CASE REPAIRING.

### BLISTERS.

**B**LISTERS only occur in veneered work; but, as the majority of pianos are veneered, this is consequently a common occurrence. The first thing to do in a case of this kind is to remove the polish, or what remains of it, from the surface of the veneer as far as the blister extends. This is best done by means of a piece of glasspaper folded over the fingers. The removal of the polish is to allow any moisture which may have been the cause of the blister to evaporate, which it will do more freely when the wood is brought in contact with the air.

When the groundwork is quite dry, cut about half-way round the blister with the point of a sharp penknife, endeavouring to follow the shape of the blister as far as indicated, leaving the sound portion of the work on the outside of the circle; whilst the veneer which has become detached from the groundwork will be within the circle which the knife has partly inscribed. As far as

possible, cut *with* the grain of the veneer, starting on that side of blister which will best allow of this. The reason for following the grain is because a cut in the veneer at right angles with the grain is more easily perceived than one that runs with the grain.

Next take a thin dinner knife and pass it under the flap of the loose veneer, gently pushing the blade to the full extent of the blister; then, after having warmed the blade by dipping it into boiling water, take a pot of hot glue of medium thickness, dip the knife into it and repeat the process, pushing the tool with the hot glue on it as far as possible and with reasonable pressure, moving it about freely to ensure the glue covering the whole of the surface of the veneer.

A small quantity of glue should be allowed to remain on the upper or outside surface of the veneer. This outside glue, to which should be added a little water, will act as a lubricant for the hot iron which must be passed over the portion of the veneer under which the glue has been laid with the knife. An ordinary laundry iron of medium size will be found very suitable for this work. Care should be taken that the heat of the iron is not so great as to turn the glue white, which it will do if too hot.

After the iron has been passed over the damaged place long enough to thoroughly warm up the glue under the veneer, a hammer rather more than an inch wide across the back (or narrow) part should be taken, and with it all the superfluous glue squeezed out from under the veneer. It will be scarcely necessary to point out that this squeezing must be done from the side of the blister which is opposite to the semicircle which has been cut. If the work has become chilled whilst this is being done, it must be at once warmed with the iron and moistened slightly with a wet rag at the same time. Care must be taken that the pressure on the hammer used to rub down the blister is not excessive, as otherwise ugly grooves in the veneer will result. The object should be to get as much glue as possible from under the veneer by a series of short rubbing strokes with the hammer, which should be used as far as practicable with the grain of the wood, or only slightly diagonal thereto. This done, the surface should be wiped as clean and dry as possible with a damp rag.

The work must now be allowed to rest for at least two days (a week is still better), in order that the whole may become perfectly dry and hard. Now make the surface level by means of a scraper, which should be used in as many different directions as possible across the part to be levelled, still bearing in mind however that the tool must never be allowed to cross the grain of the



veneer at right angles, as in so doing there is great risk of tearing up the veneer from the groundwork.

[THE SCRAPER.—It may not be altogether out of place here if, for the benefit of the uninitiated, we leave our subject for a moment to describe that most useful tool,—the scraper, which plays so important a part in the making of a level surface in all woodwork which has afterwards to be French polished and which consequently has to be levelled and smoothed with the utmost care so that there may appear no wrinkles or waves in the polish when finished. A scraper is simply a piece of soft steel about three inches in width, some five inches long, and a sixteenth of an inch in thickness. Its four cutting edges are made by being rubbed alternately on its edge and its flat on an oilstone until the two edges are quite smooth and square. Then on each of these edges two burrs are thrown up by means of a stout marking awl, which should be held almost square across the edge of the scraper and with the slightest inclination towards its flat, and then drawn three or four times smartly and firmly from end to end of its edge. Then reverse the scraper, and with the marking awl inclined slightly inwards as before throw up a second burr on the same edge. The reader will thus observe that we have two burrs or edges on one edge of the scraper, each one turning inwards towards the flats. After this has been accomplished, treat the second edge of the scraper in the same manner, and we shall then have four cutting edges to the tool, each one capable of taking a fine feathery shaving off the surface of the wood over which it passes. When the scraper becomes so blunt that it makes dust instead of shavings, it should be resharpened by laying it flat on the bench or table and passing the marking awl a few times over it, the object being to throw the burr back towards the edge so that a fresh one may be created by using the marking awl as first directed. When, however, the awl fails to turn the edges as desired, it will be necessary once more to resort to the oilstone in order that they may be made quite smooth and square, as before.]

Now that the surface of the veneer has been made level and free from glue, a sheet of glasspaper should be folded over a flat cork rubber and the affected part made quite smooth and ready for the reception of the polish, which will of course be applied in the usual way and which is fully described in a previous section of this work.

### PATCHING DAMAGED VENEER.

In the foregoing it has been assumed that the veneer has been blistered by water or some other fluid, in which case most probably the veneer itself is uninjured. There are, however, other means by which blisters are caused in veneered work, such as by lighted pipes, cigars, &c., being laid on the instrument. In cases such as these the veneer will most likely be so scorched as to necessitate the inlaying of a new piece. In this event it is desir-

able to select a piece of veneer as nearly as possible like the original in grain and colour. This should be cut to a rough size, —say, half an inch larger than the damaged part. It should then be laid over the place it is intended to occupy. A few tacks driven lightly through the patch will prevent it from slipping about. Then with a sharp penknife cut through the piece of veneer about an eighth of an inch from its outer edge, working right round the patch until the point at which the knife started is reached. Sufficient pressure should be put on the knife to cut through both the patch and the original veneer on the part being repaired, so that when the tacks are withdrawn a cut describing the exact size of the patch will be seen underneath. It will now only be necessary to remove the damaged veneer inside the cut which the knife has made in order that the patch may be dropped into its place, after which it should be glued and rubbed down with a hot iron in the manner previously described.

### BRUISES AND DENTS.

As most dealers know, bruises and dents are of only too frequent occurrence. The situation and nature of a bruise will have much to do with the mode of treatment adopted to put it right. A long shallow graze or scratch may often be removed by simply using a scraper until the injury becomes very faint or is altogether removed. In all cases, however, the use of the scraper must be followed by a thorough scouring with glasspaper until the surface is quite smooth, it being the function of the scraper to make the surface level, whilst it remains for the glasspaper to put the fine smooth face to the wood necessary for all polished work.

If the surface being operated upon should happen to be a veneered one (as it is very likely to be), first ascertain whether the bruise is deeper than the thickness of the veneer. If it is deeper, it will be necessary either to swell up the most indented portions of the bruise or resort to shellac or a composition known as "stopping" to fill up the deeper parts of the indentation. The only other alternative to these methods is to let in a piece of veneer or solid hard wood, such as walnut or mahogany, the latter being most suitable for a rosewood piano.

The process of swelling out a bruise is performed by holding a hot iron on the affected part, several thicknesses of wet rag being held between the iron and the bruise. The steam thus set up penetrates the surface of the wood for some little depth, causing the fibres of the wood to expand to their normal or original state. An old file set in a rough wooden handle makes a capital tool for this work, as it can be heated and used in much the same way as a plumber uses his soldering iron; and it is capable of being applied to a small dent or bruise without affecting a large area of the surrounding surface, for it is almost needless to point out that so far as the heat of the iron extends the polish will be destroyed. It is essential that the cloth placed between the iron and the damaged part be kept fairly moist, so that the steam may be maintained.

If during the process the veneer should happen to blister or become detached from the groundwork, an incision should be made in the blister and a little glue run under it, and then rubbed down with a hammer, as previously described.

After the bruise has been swollen out, it is desirable to allow it to rest till the next day, in order that it may be quite dry and hard before being cleaned up with the scraper and glass paper. If, however, it is impossible to let the work rest this length of time, it may be dried by passing the hot iron over it a few times, and then letting it rest for an hour or so in order to allow the glue under the veneer to set.

If after the work has been levelled over with the scraper there still appears some portion of the bruise which it is impossible to get out with this tool, the indentation may be filled in with a little shellac, for which purpose the iron used to swell out the bruise will answer very well. Care must be taken, however, that the iron is not red hot, else the shellac will be burnt almost black,—thereby making an unsightly patch when cleaned. It is a good plan, when stopping a hole by these means, to make a few small pricks with a marking awl at the bottom of the indentation; this will enable the shellac or “stopping” to take a firmer hold in the wood than it would otherwise. The shellac should also be well pressed into the hole (whilst hot) with the finger or the back of a chisel.

The “stopping” referred to is a composition similar to sealing wax, and is sold in sticks of about the same size. The only advantage it possesses over shellac is that it may be purchased in various colours to match the different kinds of wood; it is obtainable of most oil and colourmen, and also of some veneer merchants.

If it is proposed to let in a piece of veneer in preference to the method just described, the reader need only be referred to the first part of this chapter, where a brief description of inlaying is given; but it is only advisable to adopt this course when the bruise is of a flat or shallow nature. When there is an acute or deep dent, it will be better to let in a piece of solid walnut or mahogany, as previously suggested. To do this it will be best to make the piece of wood the exact length and width required, so that it may be placed over the hole it is intended to occupy; then with a sharp pointed marking awl scribe round it, afterwards cutting away the wood within the line with a chisel and mallet to the depth of about a quarter of an inch, taking care to leave a slight trace of the line, so that the piece of wood may fit tightly into its place. After this has been done satisfactorily, the piece of wood should be made hot, and both it and the place it is to occupy well glued. All that remains now to be done is to drive the piece of wood into its place with a hammer; no hand screw or other pressure will be required if the block has been well fitted.

The work must now be left for a few hours for the glue to set hard. Next, that part of the block which projects must be planed off level with the surface. It is advisable when doing



this to use a finely set plane for the last few shavings, as a coarse plane is almost sure to catch and tear up some of the surrounding veneer. Finish off the surface with a few rubs of glasspaper and the work will be ready to polish.

### DAMAGED MOULDINGS, TOPS, &c.

Before leaving this part of the subject, it will be well to devote a small space to the consideration of bruises in mouldings, edges, &c. If the damaged moulding happens to be on a prominent or projecting part of the instrument, such as the lock-board or the end of the top, it will be well if possible to abstain from the use of shellac or any similar substance when repairing, the reason being that the least tap or knock is sufficient to cause the shellac to crack and crumble out of its place; its employment is only safe where it is surrounded by wood and so situated that the probability of a blow is remote. In cases where the mouldings are of solid walnut or some similar wood, it is often possible to plane and "work back" the moulding till the bruises have quite disappeared. Care must be taken, however, that each member of the moulding is "worked back" equally, so that its perfect shape may be retained. The process of "swelling out" bruises, as previously described, will be found most successful for solid mouldings.

To "clean up" mouldings well, it is absolutely necessary to have three or four nicely shaped wood "rubbers" on which to stretch the glasspaper. These should be made of pine or some equally soft wood, and should be about an inch in thickness for large sized mouldings, whilst a quarter or three-eighths of an inch will be found about right for small ones. These rubbers should be about five or six inches long and about three inches in width, the edges being shaped into hollows, rounds, and bevels of various sizes and angles. A little care and time spent in making these handy little tools will be amply repaid.

There is yet another method by which bruises may be taken out of the edges of tops, lock-boards, plinths, &c., and that is by making a cut with a sharp penknife a full sixteenth of an inch below the bruise. When the knife has been passed under the bruise to a sufficient depth, a little hot glue must be rubbed in and then a nicely shaped wedge of wood of suitable thickness tapped into the incision. This will have the effect of forcing up the indented wood until it is once more level with the surface. It will be obvious to the reader that this method can only be adopted when the dent or bruise is near an edge, as the surface into which the knife is introduced must be at right angles with that which is bruised to enable the knife to pass *beneath* it. It is also advisable to make the wedge used in this process with an oval or semicircular tip and so fashioned that it thickens well a short distance from the point: lacking this point it will fail to drive out the bruise as desired. After the wedge has been glued and driven in as far as required, it must be cut off level and both it and the bruise rubbed down flat with glasspaper stretched on a wood rubber.

## GLUEINGS.

All glueings should be performed as speedily as possible, everything being prepared and ready to hand before the glueing is commenced. It is also essential that the surfaces to be glued together should be quite clean and free from dirt and grease of every description; also that, where the glueing is important, one portion of the work should be made hot whilst the cold surface is being glued. Moreover, it is absolutely necessary to use sufficient pressure by means of clamps or hand screws to squeeze out all superfluous glue. These screws should be allowed to remain on for several hours after being applied; indeed, where there is much resistance or difficulty in getting the work down, the screws should be left on until the following day.

The consistency of the glue used for hard woods should be slightly stouter than that used for soft woods; but in no case should glue be used so thick that when the brush is dipped into it and held up it clots and runs sluggishly back into the pot. Of course, on the other hand, it is equally necessary that it should not be thin and watery, which condition will affect the strength of the glueing. Glue must be made thoroughly hot before any reliable opinion can be formed as to its thickness. Scotch glue is the best for general purposes, as it possesses the advantage of not congealing so quickly as the foreign.

In glueing down a small blister—say, no larger than a half-penny—it will scarcely be necessary to use a hot iron if the work be performed smartly, and the knife warmed before being used for the glue. If, after the veneer has been glued down, a lapse of several days is allowed before the work is cleaned up, the surface of the polish when finished will be far superior to what it would be if only allowed to stand for a few hours.

## KEYS.

## MODE OF MANUFACTURE.

**KEY-MAKING** is a trade separate from pianoforte making. Some manufacturers make their own keys and actions, but they are in a minority. Machinery has now entered largely into the manufacture, many processes being performed by mechanical means which were formerly done by hand. The keyboard panels being jointed up and prepared, and key frames made (these have now many years been imported all ready jointed).

It will now be as well to give the reader some idea as to how ivory is laid on the keyboard. When the ivory has been matched up—this is usually done on a wide blackboard where perhaps a dozen sets of ivory heads and tails are placed in rows—the matcher slides one or two pieces at a time, and places them in a different position in the line, according to the colour or grain.

The keyboard having been prepared with a coating of white lead and size, the front slip is now glued on and pressure applied. Now the ivory heads are shot straight on a shooting board with a steel-faced plane; an iron or brass plane would leave a black mark on the end of the ivory, which would show a black mark joint. A straight-edged piece of wood is fastened across the board where head and tail meet. Each ivory head is glued with Salisbury glue, which is transparent, or nearly so, and rubbed up to the straightedge. While this operation is proceeding a heavy zinc caul is being made hot, a strip of baize is put across the ivory, the caul laid on and pressure applied. The tails are laid after the heads are dry. These are glued and a tapered nail (like a horse-shoe nail) is driven behind each one. This springs the tail up to a close joint with the head. Now a caul is screwed over these. The keys are of course marked out and holes bored through keyboard into frame for key pins before ivory is laid. The ivory is planed, scraped and polished with methylated spirits (on a pad of felt), combined with putty powder and whiting. The keyboard is now cut apart and the keys carefully finished and spaced on the key frame, which is now pinned in the holes bored through the keyboard. The sharps are now glued on the keys. This is usually the method followed, but the repairer knows the difficulty of getting a good joint with ivory that is badly matched, and not having the tools and experience of the professional key maker. It is best to follow as near as possible the method of the key maker. If the head is off the key, take the tail off also; then, after glueing the head, spring the tail to a joint, being careful to use the white lead covering and a little white lead with the Salisbury glue. I have seen glue as black as one's hat used for glueing on ivory, and the person who used it affecting surprise at the black joint.

### RECOVERING WITH CELLULOID.

Recovering keys with celluloid is a little different to ivory, as the celluloid is in a sheet. To recover keys with celluloid, remove the old ivory with a knife; a damp cloth and warm iron passed over will help the removal considerably. Procure a flat board and put on a couple of strips of brown paper with glue, one at front and one at back edge of board. Put a spot of glue on back and front of each key and stick on paper. Between each key a space must be left for sawing through. Usually an old ivory head used for the purpose will suffice. Place and keep the keys as level as possible. Pressure must be applied according to the facilities at hand. If it is not practicable to lay the whole sheet, it may be laid in sections of, say, two octaves at a time. A wood caul will be necessary to make hot to cover the top and handscrews for pressure. Scratch the celluloid on the surface to be glued with the teeth of a saw, so as to roughen it, and then put on methylated spirits and allow to stand a little time to soften the surface. Now glue carefully the tops of keys. Put celluloid on and put a tack or two in the back, to keep from moving. Place on the hot wood caul and press down with handscrews.



When the glue is dry it is easy to tear away from the brown paper, turn over on board and cut apart with fine saw, cutting spaces for sharps with saw and sharp knife, and filing level with wood and bevelling edges and rounding corners. Rub the surface with fine glasspaper and polish with pumice powder and water, and finish off with spirits and water on leather or felt pad.

### THE KEY FRAME.

In many repairs it will be necessary to take up the keys and examine the key frame. If the cloth on either back-touch, balance or front rail is touched with moth, or otherwise defective, replace with new cloth of exactly the same thickness and texture. The repairer's tool outfit should contain  $\frac{1}{16}$  in. and  $\frac{1}{8}$  in. centre punches for cutting new balance cloths or front baizes; but these can be purchased in sets already cut.

### SCRAPING AND POLISHING IVORIES.

The ivories are sometimes found to be "spooned,"—that is, worn hollow by the continual playing of many years. They are usually in this case somewhat yellow and discoloured, so it is necessary to plain or scrape them in order to bring them quite square and flat again, and to remove the discolouration. Very few modern ivories will stand this treatment; indeed, it is only upon the best instruments that ivory is found at all. Owing to the decreasing supply, and consequently increasing cost of ivory, celluloid has come more and more into use for cheap and medium class instruments; and even in the case of ivory keys the ivory has been cut so thin that planing or scraping is out of the question, recovering being the only course.

Old keys were covered with good solid slabs of ivory which would, if not gone too far, stand such treatment as is necessary in this instance. Place the key along the edge of the bench, and fix it with a hand-screw firmly to the bench. With a sharp stiff scraper or an ivory plane work the ivory from end to end. Take particular care to keep the scraper quite square with the key, and perfectly steady, or more will be taken off one side than the other, and a little hollow will be cut just at the joint in the ivory, which is worse than the "spooning" itself. Hold the scraper diagonally to the key in order to avoid this. Having scraped all the keys, tack a few sheets of No. 1 paper and a few sheets of No. 0 to a board, and paper the ivories first upon No. 1 and then upon No. 0. Keep the keys perfectly flat and square upon the papers, and carefully take out all scratch marks. Slightly round the sides and fronts of the heads in order to take off the sharp angles, and round the front corners as before. When the ivories are all papered, tack a piece of stout box cloth to a board; soak it with water and sprinkle with whiting; polish the ivories on this prepared cloth, keeping it quite moist all the time. Finish off each key upon a piece of dry cloth sprinkled with dry whiting. Do this cleanly so that whiting does not get half way up the key and into the balance pin holes.

## REPINNING KEYS.

Often the keys have to be tightened, and in a bad case it will be necessary to repin the key frame throughout. Some keys can be hammered up tight to the balance pins, or can be wedged at both holes; but the quickest, cheapest, and best course is to repin the frame. Screw down the frame to the bench with four or five of its screws, in order to keep it flat, firm, and true. Remove all the old pins, except the two end ones of each row. Hammer in the new pins, which should fit tightly, even the loosest of them. If the front holes are long enough, use "cricket bat" pins, which are always adjustable; if not use ordinary round pins. If the new pins are much larger than the old ones, ease out the holes in the rails, so as not to risk splitting the rail all along. The new pins should be as nearly as possible the same length as the old. Tap in the pins lightly but firmly. Cut a small wood block the height of the old pins; bore a hole through it large enough to pass easily over the new pins. Drop this block over each pin and drive it down level with the top of the block, so that the pins will all be the same height. Tap the pins into line with the old pins from end to end, using a straight-edge. Ease the keys to the pins; press down each key upon the pins, and then with a mortice key file remove the mark or impression made upon the sides of the mortice holes, so that the key works freely but has no side shake at either hole. Space keys as nearly and evenly as possible; then remove them all again from the frame, so that it can be restored to the frame.

Replace any card or veneer packing, and screw down the frame into position. If the key bottom and key frame were properly made and fitted originally, the back-touch, balance, and front rails should all answer truly to a straightedge placed along them. Replace all the cloths and the back-touch baize, followed by the keys. Again, if the keys were properly gauged and made, and the frame lies properly also, the straightedge should show a true line along them just in front of the hoppers; also at the balance rail, and again along the key heads. As a matter of practice, this is seldom the case. The back-touch may be true, but the cloths on the balance rail may not be all exactly alike, so that the keys must be made up with paper to bring them level at the front; or a key may "cast" ever so little in its horizontal line, with the result also that the head gets out of line with the others, necessitating some raising or lowering upon the balance rail.

A diagram of a key and its auxiliary parts will be found on page 78.

## HAMMER COVERING.

WHEN hammers have to be recovered, it is far better, and cheaper, to send modern or comparatively modern hammers to a regular hammer coverer. It is a business by itself, requiring much practice and skill and considerable physical strength; but the method of working is as follows.

Remove the covering from the first and last hammers as patterns for length and thickness. Order or cut a set of felts "to pattern." Take off all the old top felts. Remove the old glue from the woodwork of the heads and re-tooth it with a file. Make sure that the length and thickness of new felts are correct. Then glue the top of each head, half way from the shoulder to the point, but *do not glue the point*. Put the felt on to the top only. Put a spring on each one, doing a dozen or so at a time, and shifting the springs along as wanted. Of course, the more springs the better. Be sure that the felt fits squarely to the shoulder of the head and runs in line with the head itself. Let this top glueing dry thoroughly.

Then turn the hammers over. Glue the under sides of the heads in the same way, still putting no glue within half an inch of the point of the hammer. Pull the covering tightly round the head, and put the springs on again to hold it into position. The glue must be very good indeed, not too thin, and boiling hot. (In glueing felt, leather and cloth to wood, always apply the glue to the wood and not to the cloth; the only exception to this rule is in the case of bushing, when it is of course impossible to get at the wood to glue it, and in the hanging of sticker hinges.) When this is all dry, cut the felt cleanly and smoothly flush with the sides of the head, which should leave the felt clean, square and firm.

This is a job requiring considerable practice, and time and money is usually saved by entrusting it to a professional coverer.

Do all that may be necessary to the hammers in the way of cleaning or re-bushing, and get them quite free from dust before the covering is done, because the less the clean felts are handled the better the job will look when it is finished.



## General Hints.

### BLACKLEADING ACTION.

Do not put on blacklead too thick; if so, when burnished it falls off. The following process is advisable: Get a small tin of specially prepared blacklead (obtained from one of the supply houses); mix as much as is likely to be required for the work in hand with very weak glue water; only a few drops will be necessary. When it is thoroughly incorporated, place in a saucer and keep warm over the glue pot. This will keep it in a liquid state. Put a thin coating on the work, and when thoroughly dry burnish with a piece of smooth steel.

### CLEANING ACTION.

THE woodwork of an action may be bleached by oxalic acid. A pennyworth dissolved in half a pint of warm water. Rub over with rag and when dry the wood will become white. Rub a wire brush over screw heads to take off rust; and this brush is also useful for cleaning rust off strings. The metal hammer rest can generally be cleaned with methylated spirits; the hammer heads with a little polish (if not white) and the damper wires with metal polish.

### KEYS.

KEYS stick from many causes, the commonest being damp. With bushed keys the cloth comes away from the wood and causes trouble, or the wood itself swells. Keys sometimes cast right or left, and hold each other. At other times a lock rail will cast inwards, binding the fronts of certain keys; in which case, ease away the inside of the rail. Sometimes some chemical action has taken place in the key leads, causing them to enlarge and to touch each other. This is cured, of course, by cutting the leads flush again with the woodwork. To make a touch *lighter*, insert key leads in the front portion of the keys, as far forward as possible; to make a touch *heavier*, insert more key leads in the back ends of the keys. Use a centrebit of the exact size of the leads; hammer them in to fix them, and clean off quite flush on both sides.

### DEFECTS OF TOUCH.

THESE may be caused by stickers being too long or too short,—that is to say, set up too high or too low; by worn notch pieces in the hammer butts; by defective or worn checking; by settlement of the front baizes, allowing the touch to become deeper

than originally made; by defective or imperfect set-off, or by worn key or plunger cloths. All these ills suggest to the observant mind their own remedies.

### THE HAMMERS.

HAMMERS will *slap* if the covering is loose (in which case reglue the felt and run a T-pin through the felt and head, clinching it upon the underside of the hammer); if the shank is loose either top or bottom, or if the shank is split; if the centre is loose, or the butt is not firmly screwed to the rail.

Hammers will *stick* if the centre cloth has swollen at all from exposure to damp. To cure this, broach the centre bushing cloth, or insert a smaller centre pin; but remember that a centre pin must fit exactly. If tight, the hammer sticks; if loose, the hammer slaps. Hammers will sometimes catch upon the treble bridge pins; in which case either paper the felt lightly in order to allow the hammer head to clear the pin, or hold the head in the casting tongs until the glueing of the shank is softened enough to allow the head to be bent down ever so little to clear the pins, or even remove the few heads entirely and shorten the shanks as may be necessary. Mind that the hot iron does not lift the hammer felt.

Hammers sometimes catch up beneath the damper heads; but in that case the remedy is to the dampers and not to the hammers.

### REPAIRING FORKED GRAND HAMMER SHANK.

REMOVE the portion which is fixed in the head and fit an ordinary hammer shank. Now pare away the part on which the fork is made; and, after having done the same to the new shank (but on the opposite side), glue and tie with thread. If this repair is neatly done, the thread may be removed when the glue is set and the shank will not break in use. Forked hammer shanks can be obtained, either from the pianoforte makers or any of the supply houses, and when possible an entirely new shank should be fitted. When the hammer head is held in the fork, leaving room for the check (sometimes erroneously termed "a guide spoon") it is not so easy to obtain a new shank. Glue a strip of wood on either side of the fork, bind until the glue is dry and reduce the thickness of the splints so that no obstruction occurs.

### CLICKING HAMMERS.

THERE are several things likely to cause clicking, the most frequent perhaps being the fact that the hammer shank has not been firmly glued either in the hammer head or in the butt. It is the practice of some finishers to reduce the shank almost to a point when fitting the hammers in the action, with the result that after a time a clicking noise is produced though apparently the shank is tight in the butt. The remedy in this case is either to take out and reglue or to fit a new shank. Any fracture, however

slight, in the hammer head, shank or butt will be likely to cause noise and these should be examined carefully. Looseness on the centre must also be looked for, especially where a metal plate is used to hold the centre pin. Lastly, worn hammers are likely to click when the felt has worn in deep ruts; and the hammer by striking with the felt and immediately slipping into the rut gives out a distinct click which would give one the impression that something was loose. This will only happen when the hammers require recovering. It must be definitely ascertained that it is the hammer which is at fault, because a noise in the action is just as likely to occur in the jack or key,—for instance hammer loose, notch worn, damper lever spoon under the cloth instead of on it, &c.

#### TAKING BROKEN SCREWS FROM HAMMER RAIL.

THE best plan is to employ a shell bit in the stock that moves round the broken screw without touching it. When the depth of the screw has been reached draw the bit out and the broken screw will come out with the wood core. Sometimes it is wise economy—if there are many hammers and butts broken—to send the hammer rail to a supply house for a new set of butts and hammers.

#### DAMPERS.

IN the case of dampers, get or cut the felt to pattern. Remove the old felt, and replace the outer cloth if necessary. Clean damper heads, and glue felt in as before. Damper felt is difficult to cut cleanly and neatly if one is not used to it. The heads must be in line top and bottom, as must be the front surface of the felt, or the damper levers will be all sixes and sevens when the dampers get upon the strings.

Dampers frequently settle or bed down to the strings so much as to bring the lift buttons at the bottoms of the wires right down upon the damper levers, thus holding the dampers just free of the strings all the while. The quickest remedy is to shift the damper rail so far back as to bring the dampers to the strings, and enough to raise the lift buttons clear of the levers, as they were (or should have been) originally. Some damper rails will cast downwards, so as to bring the bottom edge of the damper head low enough to catch up each hammer as it strikes the string. In this case, of course, raise the damper rail itself, and, if necessary, insert a supporting pin in the plank to hold up the rail.

#### TO DRAW HITCH PINS.

IF the bent side is wide enough, other pins could be put below the original. If it is narrow, the only way is to take out the key-frame and cut a piece out of the back rail of the key-bottom on the dovetail, which could be glued in again just enough to allow the use of a drill to bore fresh holes or to draw the old pins. The most satisfactory way is to rub off a scale and to have a bent side plate made with the pins in, then screwing it on the bent side.



## THE STRINGS.

ALWAYS replace a string with steel of the same gauge. Wire that has been kinked in the stringing will always give a false note.

Strings will jar if they are too close together under a pressure bar; if the top bridge pins are loose or have shifted; if the bridges have not been sufficiently cut away to give room for the vibration of the string: if the top and bottom lengths are insufficiently listed; if any portion of their vibrating length comes into contact with any part of the action or keys.

## TUBBY BASS STRINGS.

BEGIN by altering the down bearing of the strings on the lower (sound-board) bridge. Next, alter the disposition of the bars behind the sound-board. Now find out whether the maker has, by chance, allowed room for the sound-board to vibrate by leaving a part unglued at the bottom. It is important to observe that the ends of the bridges do not come in contact with the bars of the iron frame; this is often an unsuspected cause of dulness in tone where the breaks occur.

## DEAD BASS STRINGS.

SOMETIMES this will occur through the copper not being wound tightly; but another cause is corrosion of the copper caused through damp and tarnish and sometimes through mice running over and moistening them. Try brushing briskly with wire brush. This will remove dust and tarnish. If this fails, renew the strings.

## CLEANING COILS.

THIS is done by employing a strip of leather about a quarter of an inch wide on which a little bath brick has been rubbed. In order to hold the leather on the coil, it is necessary to use a piece of wood with a hole in one end so that it may be fitted over the head of the wrest pin. The method of working is as follows: Place the leather strip on the coil (after having drawn it across the piece of bath brick) and the stick on the wrest pin; now press against the opposite end of the stick, at the same time using both hands to draw the leather backwards and forwards over the coil. It is a good plan to insert a screw in the bottom of the hole in the stick to enable the depth of the hole to be adjusted to suit the varying lengths of the wrest pins, the best results being obtained when the stick just reaches the coil. For very rusty coils a little paraffin may be applied with a small camel hair brush, great care being exercised in order to avoid any oil spreading down the pin.

## TO SHORTEN COVERED PIANO WIRE.

THE covering should be taken off by cutting through the copper with a chisel in such a manner that the covering is removed in rings. This will leave the portion that is wanted undisturbed. Do not unwind the copper covering.

## THE WREST PINS.

SOME makers drive in the pins so tightly that only a lever hammer will turn them, and now and again a pin breaks off short at the wire hole. Use a proper pin extractor, which cuts its way *on* to the pin with a left-handed cutting thread, and then removes the pin in the ordinary way. The old method was to cut an oblong on the broken pin with a cold chisel, and then to fit an oblong *stud* into the tuning hammer and turn the pin out. This was not always a success, and frequently ruined the appearance of the plank or pin plate.

A pin will *kick* if the hole is not quite true, or if the pin itself is touched with rust, in which case the pin should be taken out and cleaned. Dust it with chalk and re-insert it. A case in which the pins all kick more quickly produces neuralgia in the tuner than anything else.

A loose or rather easy pin may be tightened by removing it and dusting it with powdered resin. If very loose, substitute a larger pin.

A pin will sometimes make a bearing upon the edge of the brass pin plate beneath the hole. This arises from the hole in the plank being bored a little too low as compared with the holes in the plate; so that, when tension is put upon the pin, it just touches the plate, which prevents the pin gaining its proper leverage in the plank and allows it to run down every time an attempt is made to tune it. Clear away sufficient of the plate to free the pin, and the cure is effected.

A pin will *run* if the coils of steel are too low upon the plank, because each time that an attempt is made to add to that coil the pin is forced up out of the hole and loosened. In a well made plank scale each string should go direct and clear to its own pin, without touching or bearing upon any other pin.

## WREST PINS SLIPPING.

THE slipping of pins in the wrest plank is very often caused by the plank not having been bone dry at the time the holes were bored for the wrest pins, although a plank may be soft and give a lot of trouble. When the plank dries the pins work loose. It is no use putting resin or chalk in the holes in a case like this. The best plan is to put in a size larger and longer wrest pin in each hole.

## PINS BROKEN IN IRON FRAME.

If pins are broken off behind the key bottom it is difficult to get at the trouble. It is sometimes possible to drill the holes by removing the keys and cutting away a portion of the back-rail of the key-bottom. If this will not suffice, it will be necessary to unstring and take out the frame. A smith or an engineer would drill out the old pins and put in new. When unstringing, slacken and slip off frame, tying the ends of wire in batches of a dozen notes. If this is done, the difficulty of replacing is not very great.

## BROKEN PINS IN IRON BRIDGE.

DRILL out the broken pins with a hand drill and morse bit. If a small piece projects from the iron bridge file level and punch small indent for start of drill.

## BRIDGE PINS.

BRIDGE pins are usually gauged by the B.W.G. (or Birmingham wire gauge), which is the opposite to the music wire gauge. In the B.W.G., the lower the number the thicker the wire; while in the M.W.G., the lower the number the thinner the wire. Makers use various sizes, but useful sizes are Nos. 14, 15, 16; whilst for the single covered strings, say No. 12.

## BRONZING THE IRON FRAME.

FRAMES are enamelled and stoved when new, before being fitted into the piano. As this treatment is out of the question, the frame may be cleaned with soap and water, dried thoroughly and bronze paint applied. This may be obtained at oil shops or at piano supply houses; and that obtained in powder form should be obtained and mixed as required. Two coats will be necessary; and, when quite dry, give a coat of white hard varnish.

## CLEANING NICKELLED BOLTS.

IF the bolts are simply tarnished, rubbing with a piece of leather moistened with methylated spirits and whiting will clean them. If they are rusty, have them nickel plated again.

## PIANO WITH WEAK BACK.

OCCASIONALLY, owing to its being weak in the centre, the back bows forward, the plank pressing on the sound-board bulging it and causing displacement of the iron frame. To remedy, slacken the strings or (better still) take them off altogether. To strengthen the back put two more bracings in the back and stiffen the centre one with hard wood (oak or beech) glued on each side. This should be one inch in thickness and the length and width of the bracing. See that the frame is well screwed down to the back and put some bolts right through the bracings with nuts on the back. Repair any crack in sound-board with feather-edged strips of pine. Varnish after washing sound-board. Restring.

## SPLIT SOUND-BOARD.

To repair a crack or split in a sound-board at the bass end of the piano, hitch off covered strings from the bottom of the iron frame for the distance of the crack inwards and saw with a tenon saw along the split. Plane down a piece of dry pine wood to a feather-edge, have some hot glue about the consistency of cream, also have handy a warm flat iron. Having fit the splinter satisfactorily, rub the warm iron along the fissure, thoroughly warm-



ing the part. With a thin knife run some glue in fissure, also glue the splinter, and knock well in with a hammer, tapping it along till it is well down. Now rub the hot iron along again and leave to dry. When thoroughly dry, level with a plane or chisel and make flat and smooth with glass paper, afterwards varnishing with white hard spirit varnish. Examine and see whether the sound-board has pulled away from bars. If so, run glue in from the back and put a screw or two in from the front. In cases where covered strings take the covering over the bottom bridge to the plate they often wrench the bridge off and split the sound-board, as it is usually thin at this point.

### TRUSSING PIANO.

THE supply houses keep stock sizes of trusses and toes in walnut, rosewood and black. The toes are usually the thickness of the width of the plinth and have a tailpiece which goes to the back of the piano. The plinth is cut through to receive this, and the castors are screwed on the front and back of toe which is glued and screwed to the bottom of piano. The trusses are secured with screws through the toes and key-bottom. The measurements required are length of cheek and distance from cheek to top edge of plinth and also width of plinth. If required the suppliers will submit designs and prices for polished and unpolished.

### CELESTE PEDAL.

TROUBLE is sometimes caused by the centre not being held rigid. The steel rod that goes through the eye in the centre of the piano sound-board and is screwed to the céleste rail by two screws becomes loose; therefore it will not allow the céleste to rise equally at both ends. Plug the holes and put new screws in to hold absolutely tight.

### NOISES.

A FREQUENT source of worry and trouble to the tuner is the occurrence of noises in or about an instrument. They are often most difficult to locate, and such location can only be made by a system of reduction,—by trying anything and everything in which the noise might be until one strikes the spot where it actually is. Loose panels, loose washers, castors, back handles, sconces, and so on. It is most important of all to look out for sympathetic vibrations in objects in a room quite away from the piano itself. Chandelier globes, picture glasses, clock glasses, coal scuttles, glass shades, curtain rings, and such things as these have a habit of vibrating in sympathy with particular notes or chords upon the piano.

### FIXING TRANSFERS.

PASS a rubber of polish over the fall to soften the body before putting on the transfer. Then take a piece of wadding saturated with polish, squeeze out and pass over the front side of the

transfer, place face down in position required, rubbing well down to exclude air bubbles. Now leave for an hour to dry, then damp carefully with cold water, and when thoroughly saturated draw the cover down towards yourself, using both hands for the purpose. After leaving for a few minutes, wash away surplus gum with warm water and when dry polish over with white polish. If ordinary care be used a satisfactory result should be obtained.

### PIANOS IN TROPICAL CLIMATES.

In tropical climates, the wood shrinks from the extreme dryness of the hot weather, and in the wet season various parts of the action swell and stick.

It is a good plan in the dry season to keep plants near, and put water in vessels underneath a grand piano. Wide-necked bottles, with wet sponges in them, can be placed inside the back or bottom door of an upright piano, but care must be taken that they do not fall over or interfere with the pedal action. A thick quilted cover may be used as a protection from dry winds.

In the rainy season other troubles present themselves. The humidity of the atmosphere interferes with the action, causing the bushing to swell, the blacklead to wear off, the keys to stick and the strings to rust. In order to keep the instrument as dry as possible, a blanket may be used instead of the quilted cover, but the blanket must be dried thoroughly each day. Keep the piano shut while it is raining. It is a good thing to take out the top door and play upon the instrument while the sun is shining so as to allow the air inside to circulate.

In some parts of India and Burma, a charcoal fire is kept near the piano during the rains. This must be watched carefully, on account of danger from fire. There is also a risk of the polish being blistered.

A good deal of damage is done to pianos in hot countries by various noxious insects. Naphthalene, or camphor wrapped in calico are both useful in preserving the felting: about a pound should be placed inside the piano. To drive away cockroaches use powdered borax. Keating's insect powder is also useful. The deodorisers should be placed under the keys in cottage and grand pianos. Woodwork is attacked by white ants and wood boring insects. The presence of the latter plague is often revealed by a noise like scratching with the finger nails across the grain of wood. The borers are invariably found in hard wood, generally the wrest plank, and have been known to reduce a piano leg to powder. When located, which can only be done by listening carefully, a small hole may be made and a little petrol will immediately kill the insect. Should a round hole appear, it is generally the work of one of these grubs which has undergone its metamorphoses, broken through the surface of the wood, and as a perfect insect flown away. Fill in such holes with shellac, wax, or a plug of wood, but if in an important part use molten lead. White ants do not attack pianos so often, and as a means of keeping them away in districts which they are known to infest, the castors of the instrument may be stood in metal saucers filled

with water. This should be changed daily, or the ant will crawl across the dust which collects on the surface.

#### TO BRIGHTEN WAX POLISH.

To brighten wax polish, a little turpentine on a piece of linen rubbed in the wood and finished off with a dry cloth, is all that is required. Wax should not be applied. Dull polish needs nothing but a soft brush being passed along the grain of the wood. A damp cloth should not be used, as water has an injurious effect on such polish. Great care ought to be taken with dull polish, it being more delicate than any other and more difficult to repair satisfactorily.

#### TO CLEAN ENAMEL.

ENAMELLED pianofortes can usually be cleaned by simply washing with luke-warm water. If this is insufficient, the enamel should be treated as paint, and washed with ordinary yellow soap and water and wiped dry, giving heed not to scratch the surface. To frequently wash enamel is detrimental, and it should not be exposed to the sun nor subjected to the influence of great heat, which will crack the delicate surface.

#### TO CLEAN FUMED OAK.

UNPOLISHED or fumed oak should be washed with warm water, using a soft cloth (free from soap) and then rubbed dry. If the surface of the case is attended to regularly once a month or oftener if necessary, the instrument will improve in appearance as it gets older.

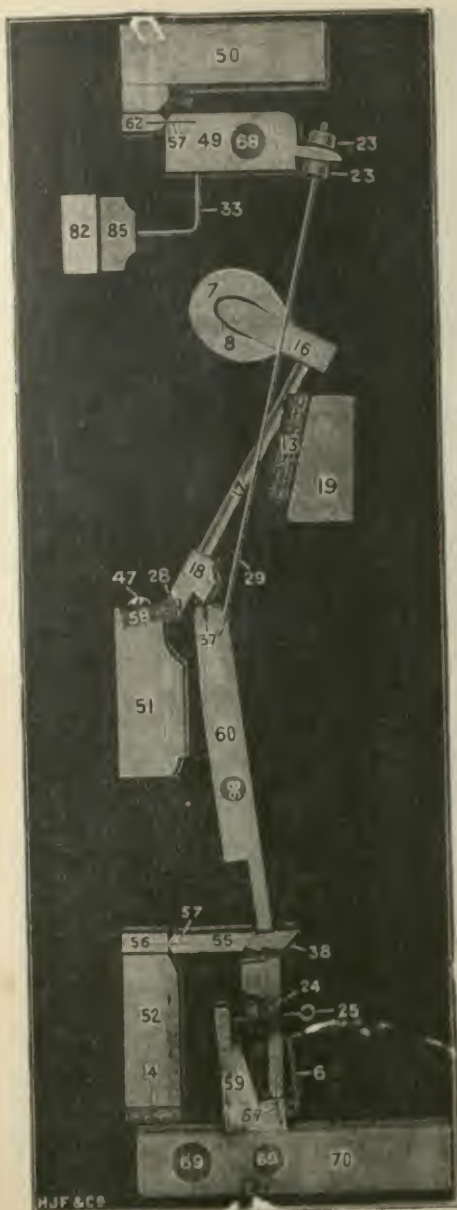
#### TO CLEAN GILDING.

UNDER ordinary circumstances the gilding in the incised work on a pianoforte will keep bright for a long time if carefully dusted with a hog's-hair brush. If the gold gets black in parts, it can be revived by warm water, applied by means of a small soft brush, almost small enough to fit the incised lines.

#### WORMS IN WOOD.

PIANOS in the Antipodes are often attacked by wood-boring worms which work great havoc. These insects, it appears, always attack woods with starch or sugar in them (such as beech, white-wood, walnut, mahogany, &c.), which they subsist on until they emerge from the worm stage with wings and lay eggs like the ordinary moth. As a remedy it is suggested that the dust should be drawn out of the holes with a suction pump and the following mixture squirted in the holes with a fine-spouted oilcan: two parts creosote, one part paraffin and one part benzoline; and as a preventative all pianos going to that part of the world should have the bottoms covered with two or three coats of Stockholm tar, as the bottom is always first attacked.

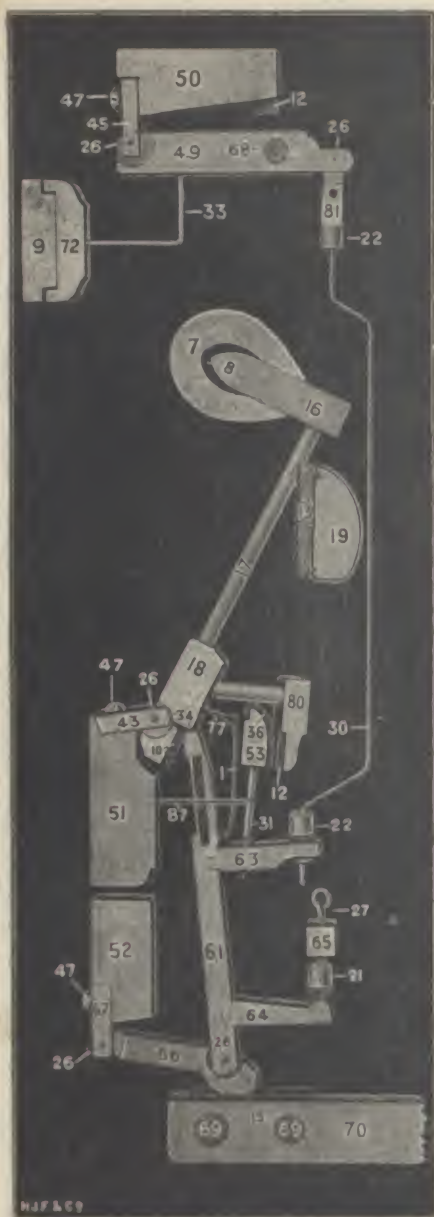




### Sticker Action.

- 6 Hopper spring
- 7 Hammer felt
- 8 Hammer felt (undercovering)
- 13 Hammer rest baize
- 14 Back touch baize
- 16 Hammer head
- 17 Hammer shank
- 18 Hammer butt
- 19 Hammer rest rail
- 23 Damper wire
- 24 Hopper buttons and cloths
- 25 Hopper pin
- 28 Centre wire
- 29 Damper wire
- 33 Damper crank wire
- 37 Sticker leather hinge
- 38 Lever leather
- 47 Flange screw
- 49 Damper body
- 50 Damper rail
- 51 Butt rail
- 52 Lever rail
- 55 Lever
- 56 Lever hinge piece
- 57 Vellum hinge
- 58 Butt plates
- 59 Hopper
- 60 Sticker
- 62 Damper hinge piece
- 68 Damper lead
- 69 Key lead
- 70 Key
- 82 Damper felt
- 85 Damper head
- 86 Sticker lead

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## Costa Check Action.

- 1 Sticker spring
- 7 Hammer felt
- 8 Hammer felt (undercovering)
- 9 Damper felt
- 10 Cushion felt
- 12 Mechanic felt
- 13 Hammer rest baize
- 15 Box cloth
- 16 Hammer head
- 17 Hammer shank
- 18 Hammer butt
- 19 Hammer rest rail
- 21 Escapement or set-off button
- 22 Damper wire
- 26 Centre pin
- 27 Set-off pin
- 30 Damper wire (check)
- 31 Check wire
- 33 Damper crank wire
- 34 Butt notch leather
- 36 Check leather
- 43 Butt flange
- 45 Damper flange
- 47 Flange screw
- 49 Damper body
- 50 Damper rail
- 51 Butt rail
- 52 Lever rail
- 53 Check head
- 61 Sticker (Costa)
- 63 Check arm
- 64 Set-off arm
- 65 Set-rail
- 66 Sticker shoe lever
- 67 Shoe lever flange
- 68 Damper lead
- 69 Key lead
- 70 Key
- 72 Damper head
- 77 Loop cord
- 80 Balance hammer
- 81 Damper lift (check)
- 87 Guide pin

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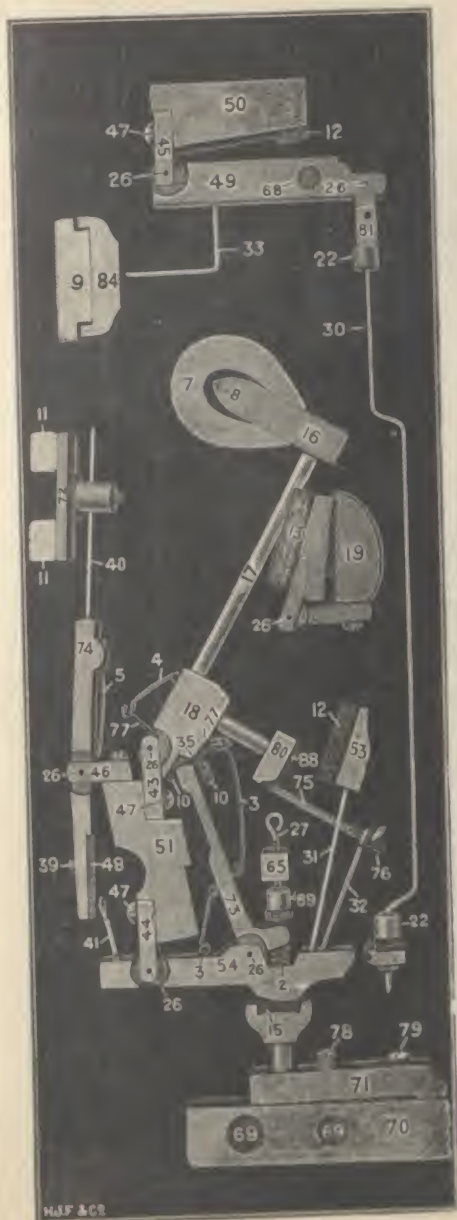
# Under and Over Damper

(COMBINED)

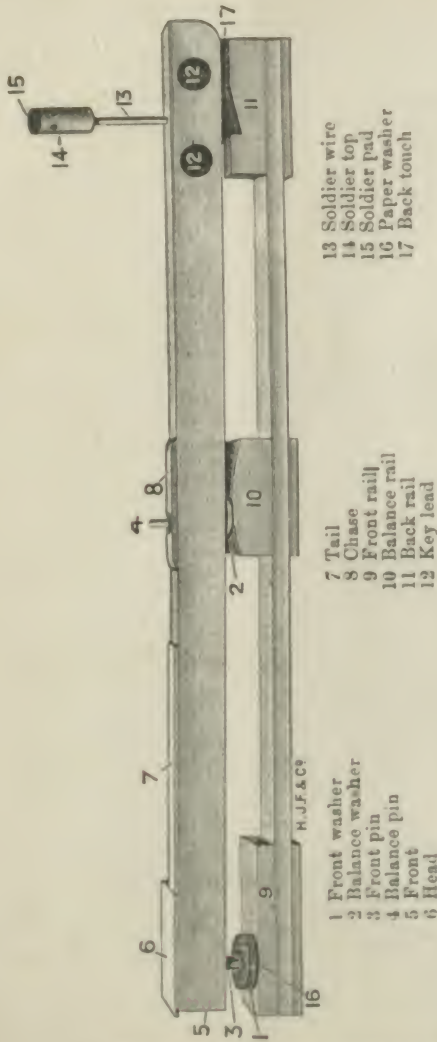
## Tape Check Actions.

- 2 Spiral spring
- 3 Jack spring
- 4 Butt spring
- 5 Underdamper spring
- 7 Hammer felt
- 8 Hammer felt (undercovering)
- 9 Damper felt (underdamper)
- 10 Cushion felt
- 11 Damper felt (underdamper)
- 12 Mechanic felt
- 13 Hammer rest baize
- 15 Box cloth
- 16 Hammer head
- 17 Hammer shank
- 18 Hammer butt
- 19 Hammer rest rail
- 22 Damper wire
- 26 Centre pin
- 27 Set off pin
- 30 Damper wire (check)
- 31 Check wire
- 32 Tape wire
- 33 Damper crank wire
- 34 35 Butt notch leather
- 39 Damper regulating screw
- 40 Damper wire (underdamper)
- 41 Damper spoon
- 43 Butt flange
- 44 Lever flange
- 45 Damper flange (overdamper)
- 46 Damper flange (underdamper)
- 47 Flange screw
- 48 Lever flange
- 49 Damper body
- 50 Damper rail
- 51 Butt rail
- 53 Check head
- 54 Lever
- 65 Set-off rail
- 68 Damper l'd
- 69 Key lead
- 70 Key
- 71 Key carriage
- 72 Damper lead
- 73 Jack
- 74 Damper body (underdamper)
- 75 Tape action tie
- 76 Leather end of tape tie
- 77 Loop cord
- 78 Rider regulating screw.
- 79 Rider screw
- 80 Balance hammer
- 81 Damper lift (check)
- 84 Damper head (overdamper)
- 88 Balance hammer leather
- 89 Set-off button

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